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TANAIDACEA (CRUSTACEA: PERACARIDA) OF THE GULF OF MEXICO. VI. ON THE GENUS *MESOTANAIS* DOLLFUS, 1897 WITH DESCRIPTIONS OF TWO NEW SPECIES, *M. LONGISETOSUS* AND *M. VADICOLA*

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ABSTRACT Two new species of tanaidaceans belonging to the family Leptocheliidae were collected from the continental shelves and slopes of the eastern and Gulf coasts of the United States. Both of these species are assigned to the poorly known genus *Mesotanaïs* Dollfus, 1897. *Mesotanaïs* is unique within the Leptocheliidae because its members lack eyes. The second supposedly important generic character, uniramous uropods, reported in the original description is considered to be a misdiagnosis. The assumption of this error is supported by the rediscovery of the type-species, *Mesotanaïs dubius* Dollfus, 1897 (Sieg and Bird, in press). In the present study, the genus *Mesotanaïs* is rediagnosed and the two new species from the western Atlantic are described. *Mesotanaïs longisetosus* n. sp. can be distinguished from *M. vadicola* n. sp. by a variety of characters including the much longer terminal setae on antenna 1, the distinctly more elongate carpus of the cheliped, and the shape of the pars molaris of the mandible. *Mesotanaïs longisetosus* appears to be closely related to the type-species, *M. dubius* known from the eastern Atlantic. It is distinguished from *M. dubius* by having an elongate distal seta on the carpus and more styliform dactylus of the first peraeopod, and by the presence of two short, distal, tergal spines on the merus of peraeopods 4-6. *Mesotanaïs vadicola* occurred at depths of 22-865 m, while *M. longisetosus* was collected mainly from the upper continental slope at depths of 545-1386 m. Between 500 m and 900 m there is a broad area of overlap in the distribution of the two species, but with increasing depth *M. vadicola* is replaced by *M. longisetosus*.

Zusammenfassung. - Zwei neue Tanaidaceen-Arten, die zur Familie Leptocheliidae gehören, wurden auf dem Schelf und dem Kontinentalabhang des Golfes von Mexiko und der Ostküste der Vereinigten Staaten gesammelt. Beide Arten werden dem bis jetzt nur ungenügend bekannten Genus *Mesotanaïs* Dollfus, 1897 zugeordnet. Innerhalb der Leptocheliidae erweist sich *Mesotanaïs* wegen des Fehlens von Augen als einzigartig. Das zweite wichtige Gattungsmerkmal, die in der Originaldiagnose erwähnten einästigen Uropoden, werden als Fehlinterpretation betrachtet. Diese Vermutung wird bestärkt durch das Wiederauffinden der Typus-Art, *Mesotanaïs dubius* Dollfus, 1897 (Sieg & Bird, in press). Die Gattung *Mesotanaïs* wird neu definiert und zwei neue Arten werden vom Westatlantik beschrieben.

Mesotanaïs longisetosus n. sp. kann von *M. vadicola* n. sp. durch eine Reihe von Merkmalen getrennt werden. Dazu gehören unter anderem die viel längeren terminalen Borsten der Antenne 1, der deutlich schlankere Carpus des Chelipedens und die Form der pars molaris der Mandibel. *Mesotanaïs longisetosus* scheint nahe mit der Typus-Art *M. dubius* vom Ostatlantik verwandt. Sie kann von dieser am Peraeopod 1 durch die lange distale Borste am Carpus und dem längeren Dactylus mit endsträndigem Dorn unterschieden werden. Besonders charakteristisch ist das Vorhandensein nur eines kurzen tergalen Dorns am Merus der Peraeopoden 4-6.

Mesotanaïs vadicola kommt in der Tiefe von 22-865 m vor, während *M. longisetosus* hauptsächlich auf dem Kontinentalabhang in einer Tiefe von 545-1386 m gefunden wurde. Zwischen 500 m und 900 m gibt es in der Verbreitung beider Arten eine breite Überlappungszone, aber mit zunehmender Tiefe wird *M. vadicola* durch *M. longisetosus* ersetzt.

INTRODUCTION

Recent ecological studies have revealed a rich, diverse, and largely undescribed tanaidacean fauna on the continental shelves and slopes throughout the world (Sieg 1984, Holdich and Bird 1985). On some areas of the continental slope the Tanaidacea may occur in larger numbers than any other malacostracan group (Sieg and Heard, unpublished data). Based on examina-

tion of collections from the continental shelves and slopes off the southeastern and Gulf coasts of the United States, the total number of tanaidacean species present in these regions may exceed 250 (Heard, unpublished data). In a recent study conducted by LGL Ecological Research Associates (Gallaway et al. 1988) on the continental slope of the northern Gulf of Mexico, over 168 different tanaidacean taxa were recorded, representing the second diverse group after

polychaetes. In total number of individuals, tanaidaceans ranked forth after polychaetes, ostracods, and bivalves. The family Anarthruridae as redefined by Sieg (1986) accounted for over two-thirds of these taxa including a large number of new genera and species. Other families represented included the Apseudidae, Whiteleggiidae, Sphyrapiidae, Pseudotanaididae, Neotanaididae, Typhlotanaididae, and Leptocheliidae.

This report, the sixth in a series on Tanaidacea from the Gulf of Mexico (see Ogle et al., 1982; Sieg et al. 1982, Sieg & Heard 1983, 1985, 1988) deals with the family Leptocheliidae, which we found to be represented by two undescribed species from the continental shelves and slopes of the Gulf of Mexico and adjacent regions of the northwestern Atlantic. A study of the literature and examination of additional congeneric material from the eastern Atlantic led the senior author to the conclusion that these two species from the northwestern Atlantic should be placed in the genus *Mesotanaïs* Dollfus, 1897, which until now had not been recorded since its original discovery. Based on these and the recently discovered specimens from the eastern Atlantic (Sieg and Bird, in press), a revised generic diagnosis for *Mesotanaïs* is presented here.

The following abbreviations are used in the figures: A.1 = first antenna, A.2 = second antenna, L = labrum, Md(r) = right mandible, Md(l) = left mandible, Mx. 1 = first maxilla, Mx.2 = second maxilla, La = labium (paragnaths), Mxp = maxilliped, Epi = epignath (=maxillipedal epipodite), Che = cheliped, P.1-P.6 = peraeopods 1-6, Pl.1-Pl.5 = pleopods 1-5, Plt = pleotelson, and Uro = uropod.

Mesotanaïs Dollfus, 1897.

Bibliography and Synonymy. — See Sieg, 1983: 497-498.

Diagnosis

Cephalothorax without eyes or visual elements. Antenna 1 in female 3-segmented, in male 7-segmented, flagellum with several groups of aesthetascs. Antenna 2 in both sexes 6-segmented. Mandibles well developed. Labium consisting of 2 lobes, outer lobe with a tiny spine-like seta. Maxilla 1 with 9 terminal spines, palpus with 2 setae. Maxillipedal coxae absent, bases not fused medially; with 2 setae near articulation of palpus. Cheliped articulated with cephalothorax by a side-piece. Peraeopod 1 more elongate and larger than other peraeopods. Carpus of peraeopods 2-3 with a tiny spine. Carpus of peraeopods 4-6 with 3 distal spines; dactylus and terminal spine fused. Pleopods of typical shape, endopodite with one inner pinnate seta and proximal with one pilose outer seta, exopodite also proximal with one pilose outer seta. Uropods biramous;

exopodite 2 segmented; endopodite multisegmented (4-7).

Marsupium formed by 4 pairs of oostegites. Sexual dimorphism well developed in antenna 1, cheliped, and mouthparts which are reduced in male leaving only remnants of maxilliped (basis with 2-segmented palpus).

Type-species

Mesotanaïs dubius Dollfus, 1897 (by monotypy).

Gender

Masculine

Remarks

The monotypic genus *Mesotanaïs* was established by Dollfus (1897: 213-214) for *M. dubius* Dollfus, 1897. Its original description, based on a single damaged specimen now presumed lost (Sieg and Bird, in press), was incomplete and contradictory. The type specimen, which lacked both chelae, was collected off the Azores in 1287 m by the R/V *Hirondelle* at Station 112 between Pico and Sao-Jorge. Lang (1967) provisionally placed *Mesotanaïs* in the family Paratanaididae Lang, 1947, but later he (Lang 1973) tentatively placed it in the Leptocheliidae Lang, 1973. Sieg (1983) listed *Mesotanaïs* with the family Paratanaididae, but then reassigned it to the family Leptocheliidae when he rediagnosed that family (Sieg 1984).

Dollfus (1897) compared *Mesotanaïs* to *Neotanaïs* Beddard, 1886 (= *Allaotanaïs* Norman and Stebbing, 1886), *Typhlotanaïs* G. O. Sars, 1882 and *Tanaïs* Latreille, 1831 because it appeared to share characters with each of them. *Mesotanaïs* has five pleonites and lacks eyes as in *Typhlotanaïs* and *Neotanaïs*, and was erroneously assumed to have uniramous uropods as in *Tanaïs*. *Mesotanaïs* can be distinguished from *Neotanaïs* by a 3-segmented antenna 1, thus it is superficially more similar to the *Typhlotanaïs*. Dollfus's characterization of the genus as having uniramous uropods is probably the result of superficial examination. The two segmented exopodites of the two western Atlantic species described here and plus those of a new species and additional specimens of *M. dubius* from the eastern Atlantic (Sieg and Bird, in press) are present, but inconspicuous and thus apparently were not detected during the original description of the genus.

The absence of eyes makes *Mesotanaïs* unique among the other genera of the family Leptocheliidae. This condition might be related to the generally greater depth distribution of the genus; however, there is a

record for one of the new western Atlantic species, *M. vadicola*, from relatively shallow water (see distribution, page 22). In all other important taxonomic characters, e.g. uropods, antenna 1, structure of maxilliped, armament of peraeopods and pleopods, *Mesotanaia* is morphologically similar to other genera within the Leptocheliidae as rediagnosed by Sieg (1984).

Within the Leptocheliidae *Mesotanaia* is most closely related to *Pseudonototanaia* Lang, 1973. As indicated by the position of the aesthetascs, the males of *Pseudonototanaia werthi* (Vanhöffen, 1914) only have a two-segmented peduncle in antenna 1 (Sieg, 1980: Abb. 12). This is also true for *Mesotanaia vadicola* sp. nov. (Figure 1). By contrast, the males of *Leptochelia* Dana, 1849 (see Sieg, 1973: Table 13; Ishimaru, 1985: Fig. 3 + 10), *Hargeria* Lang, 1973 (see Harger, 1880: Plate XIII Fig. 89), *Pseudoleptochelia* Lang, 1973 (see Sieg, 1976: Abb. 7), and *Heterotanaia* G. O. Sars, 1882 (see Sieg, 1973: Table 63) always have three peduncular segments. In *Mesotanaia/Pseudonototanaia*, as well as in Nototanaidae, the armament and the elongate shape of the first male peduncular segment clearly indicate that it actually represents the first and second segment of the otherwise typical three-segmented peduncle. Both sexes of *Mesotanaia* are similar to *Pseudonototanaia* in having only one spine on the second antennal segment and two setae near the maxillipedal palpus. *Heterotanaia*, the only other genus having one spine on the second antennal segment, can also be distinguished by having only one seta near the maxillipedal palpus. *Leptochelia* and *Pseudoleptochelia*, the remaining two genera of the family, bear two spines on the second antennal segment and always have at least three setae close to the articulation of the palpus. The endite of maxilla 1 in *Mesotanaia* bears nine terminal spine as does *Heterotanaia*, while *Pseudonototanaia* has ten and *Leptochelia/Pseudoleptochelia* have 11 terminal spines. Finally, for the spinule on the outer lobe of the labium of *Mesotanaia* might be considered as a unique character.

All information on the male stage in *Mesotanaia* is based on a damaged male, in which the distal parts of both chelae are broken off. The remains (basis, carpus) still suggest that at least in *M. vadicola* we can expect to find a cheliped-type similar in structure to those known from the *Leptochelia minuta*-group. It is quite astonishing that the huge collection available from the Gulf of Mexico (see Material Examined) did not contain a single male. In most other leptocheliid species males are quite common and are found regularly (Sieg 1984). Therefore, the absence of males in the present collections might be interpreted as a result of the temporally discontinuous sampling procedure. For more detailed information on the occurrence of males in *Mesotanaia* monthly collections may be needed.

Mesotanaia vadicola, sp. nov.

Figures 1-5, 6, 11

Synonymy: *Typhlotanaia* sp. A. (partim). - Texas A&M University, 1978: 772.

Type-material

Atlantic: 1 female, holotype, National Museum of Natural History, USNM 232786; 1 female, paratype, USNM 232787; and 1 female, paratype, dissected in Sieg coll., off South Carolina, Sta. 1247-6 (2C), 32°50'N, 079°04'W, 22 m, 20 Nov 1977.

Other material

Atlantic coast of southeastern Florida [Ocean Dredged Material Disposal Site (ODMDS), off Miami, Florida; for station data details see Table 1]: 7 females + 2 neuter, USNM 231842, Sta. 3; 1 female, Invertebrate Zoology Collection of the Gulf Coast Research Laboratory Museum, Sta. 4; 1 female, USNM 231843, Sta. 6; 4 females + 3 neuters, USNM 231844, 3 females Sieg Coll., 1 male dissected, Sieg coll., Sta. 7; 1 female + 2 neuters, USNM 231845, Sta. 8; 3 females, USNM 231846, Sta. 9.

Gulf of Mexico [Mineral Management Service (MMS)/Northern Gulf of Mexico Continental Slope (NGOMCS) study; for station data details see Table 1].

Eastern transect, off Florida, cruise II, boxcore samples; 1 neuter, USNM 232823, Sta. E2-31, samples 2380; 1 manca-I, Sta. E3-11, sample 2388; 1 manca-I, USNM 232824, Sta. E3-21, sample 2395; cruise IV, boxcore samples; 1 manca-I, dried, USNM 232825, Sta. E1-1, sample 4401; 1 female, USNM 232804, Sta. E1-2, sample 4402; 1 neuter, USNM 232831, Sta. E1-3, sample 4403; 1 neuter, USNM 232833, Sta. E1-4 sample 4404; 1 manca-II, USNM 232813, Sta. E1A-1, sample 4407; 1 female + 1 neuter, USNM 232790, Sta. E1A-2, sample 4408; 1 neuter + 1 manca-II + 1 manca-I, USNM 232815, Sta. E1A-6, sample 4412; 2 females + 1 neuter, USNM 232812, Sta. E1B-5, sample 4417; 1 manca-II, USNM 232809, Sta. E1B-6, sample 4418; 1 manca-I, USNM 232811, Sta. E1C-1, sample 4419; 1 neuter + 1 manca-II, USNM 232814, Sta. E1C-3, sample 4421; 2 manca-II, USNM 232808, Sta. E1C-6, sample 4424; 1 manca-II, USNM 232817, Sta. E3D-2, sample 4426; 1 female + 1 manca-II, USNM 232803, Sta. E3D-3, sample 4427; 1 neuter, USNM 232820, Sta. E3D-5, sample 4429; 1 manca-I, USNM 232816, Sta. E3C-2, sample 4432; 1 manca-I, Sieg Coll., Sta. E2A-1, sample 4439; 1 female, USNM 232797, Sta. E2A-3, sample 4441; 1 female, USNM 232794, Sta. E2A-5, sample 4443; 1 female, USNM 232796, Sta. E2A-6, sample 4444; 1 female + 2 neuters, USNM 232837, Sta. E2B-1,

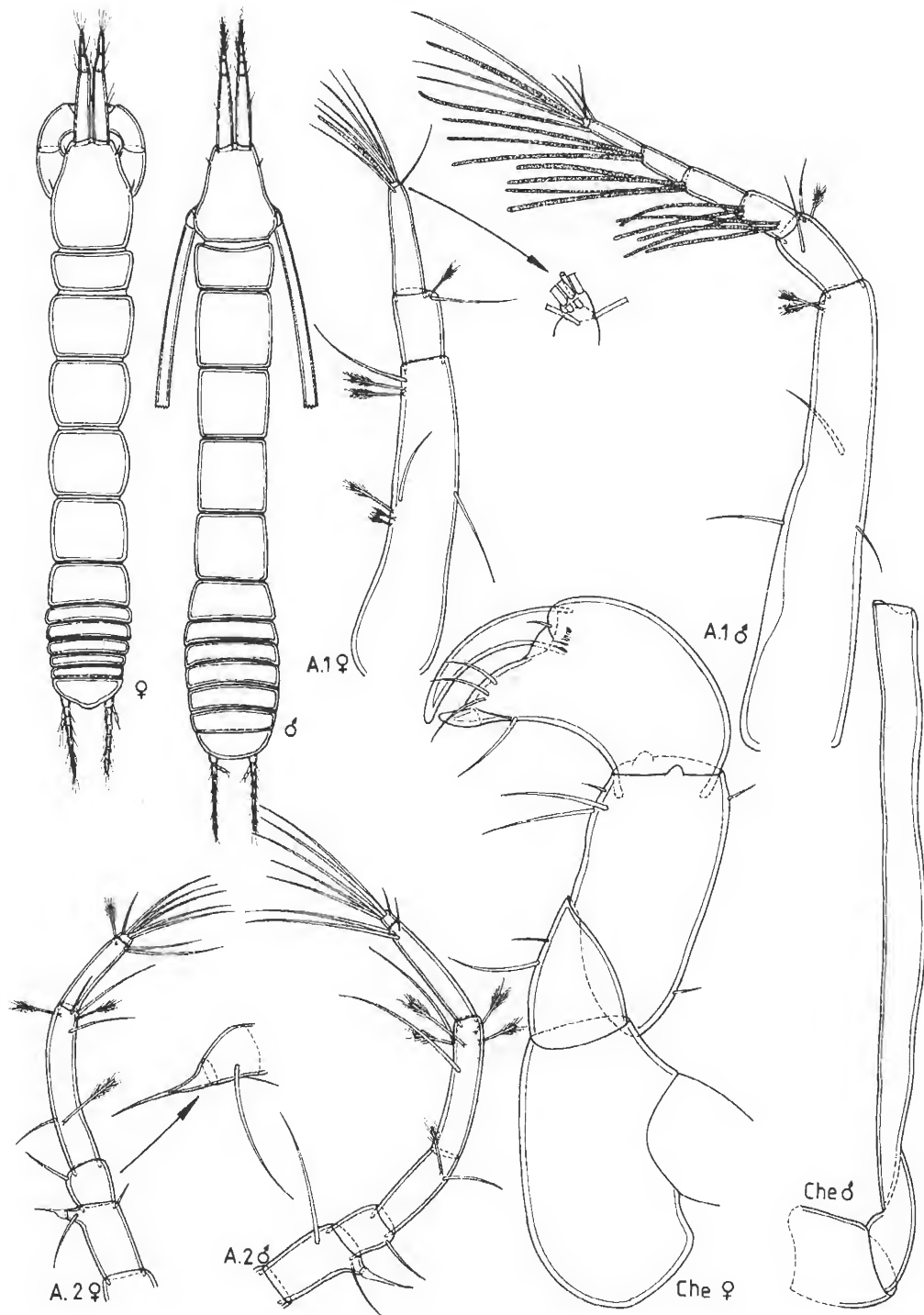


Figure 1. *Mesotanaïs vadícola* sp. nov., female paratype and male allotype.

TABLE 1

Station data for the Mineral Management Service (NMS)/Northern Gulf of Mexico Continental Slope (NGOMCS) and the Florida Ocean Dredged Material Disposal Site (ODMDS).

Station	Samples	Lat.	Long.	Depth	Date
Northern Gulf of Mexico Continental Slope Study					
Cruise I boxcore samples					
C3	197	27°49'12"N	090°07'12"W	845 m	27 Nov 83
	212	27°45'06"N	090°08'30"W	858 m	27 Nov 83
C4	363	27°29'06"N	089°46'24"W	1378 m	30 Nov 83
Cruise II boxcore samples					
W2	2025/2026	27°24'54"N	093°20'30"W	605 m	07 Apr 84
	2027	27°24'54"N	093°20'24"W	605 m	07 Apr 84
	2041	27°24'54"N	093°20'30"W	603 m	07 Apr 84
W3	2067/2070	27°10'36"N	093°19'24"W	860 m	08 Apr 84
C2	2169/2176	27°54'24"N	090°06'12"W	595 m	11 Apr 84
	2197	27°54'18"N	090°05'54"W	605 m	12 Apr 84
C3	2211/2218	27°49'12"N	090°07'06"W	834 m	12 Apr 84
	2227	27°49'24"N	090°07'00"W	840 m	12 Apr 84
	2241/2248/2249	27°49'36"N	090°07'06"W	841 m	12 Apr 84
C4	2287/2295	27°28'24"N	089°46'54"W	1386 m	13 Apr 84
E2	2380	28°16'36"N	086°15'12"W	630 m	16 Apr 84
	2388/2395	28°09'36"N	086°25'00"W	845 m	17 Apr 84
Cruise III boxcore samples					
C3	3016	27°49'37"N	090°07'05"W	885 m	13 Nov 84
Cruise IV boxcore samples					
E1	4401-4404	28°27'29"N	086°01'34"W	353 m	14 May 85
E1A	4407/4408	28°53'20"N	086°23'33"W	351 m	14 May 85
	4412	28°53'29"N	086°23'34"W	351 m	14 May 85
E1B	4417	28°19'57"N	085°46'38"W	349 m	15 May 85
	4418	28°19'52"N	085°46'21"W	344 m	15 May 85
E1C	4419	28°12'14"N	085°31'28"W	350 m	15 May 85
	4421	28°12'00"N	085°31'31"W	353 m	15 May 85
	4424	28°12'04"N	085°31'30"W	351 m	15 May 85
E2	4451	28°16'48"N	086°14'53"W	624 m	18 May 85
	4452	28°16'47"N	086°14'46"W	622 m	18 May 85
	4453/4454	28°16'46"N	086°14'46"W	622 m	19 May 85
	4455/4456	28°16'50"N	086°14'40"W	618 m	19 May 85
E2A	4439	28°35'22"N	086°46'26"W	622 m	13 May 85
	4441	28°35'16"N	086°46'24"W	625 m	13 May 85
	4443/4444	28°35'26"N	086°44'28"W	624 m	13 May 85
E2B	4445	28°18'02"N	086°18'39"W	625 m	19 May 85
	4446	28°18'38"N	086°18'09"W	627 m	19 May 85
	4448	28°18'28"N	086°18'04"W	629 m	19 May 85
	4449/4450	28°18'42"N	086°18'10"W	627 m	19 May 85
E2C	4457/4458	28°14'50"N	086°09'47"W	618 m	16 May 85
	4459	28°14'45"N	086°09'29"W	620 m	17 May 85
	4460/4461	28°14'47"N	086°09'36"W	616 m	17 May 85
	4462	28°14'52"N	086°09'29"W	616 m	17 May 85
E2D	4463	28°07'06"N	085°53'05"W	629 m	16 May 85
	4465/4466	28°07'35"N	085°52'18"W	631 m	16 May 85

TABLE 1 (Continued)

Station data for the Mineral Management Service (NMS)/Northern Gulf of Mexico Continental Slope (NGOMCS) and the Florida Ocean Dredged Material Disposal Site (ODMDS).

Station	Samples	Lat.	Long.	Depth	Date
E2E	4467	28°07'20"N	085°52'20"W	633 m	16 May 85
	4468	28°07'50"N	085°52'18"W	627 m	16 May 85
	4470	28°02'44"N	085°40'07"W	624 m	15 May 85
	4471/4472	28°02'54"N	085°39'58"W	618 m	15 May 85
	4473	28°02'11"N	085°40'56"W	622 m	15 May 85
E3	4474	28°02'11"N	085°40'59"W	624 m	15 May 85
	4481	28°09'22"N	086°24'41"W	819 m	18 May 85
	4483/4486	28°09'25"N	086°25'05"W	819 m	18 May 85
	4484	28°09'21"N	086°24'54"W	819 m	18 May 85
	4475	28°29'17"N	087°00'01"W	850 m	12 May 85
E3A	4478	28°28'47"N	087°00'01"W	852 m	13 May 85
	4479/4480	28°28'28"N	087°00'02"W	865 m	13 May 85
	4487/4488	28°07'05"N	086°19'15"W	860 m	18 May 85
E3B	4489/4490	28°07'09"N	086°19'26"W	860 m	18 May 85
	4491	28°07'04"N	086°19'08"W	860 m	18 May 85
	4492	28°07'06"N	086°19'22"W	858 m	18 May 85
E3C	4432/4433	28°15'46"N	086°36'51"W	849 m	20 May 85
E3D	4427	28°22'11"N	086°48'13"W	845 m	20 May 85
	4429	28°22'01"N	086°47'58"W	847 m	21 May 85
Cruise V boxcore samples					
WC1	5401	27°43'07"W	092°53'18"W	349 m	07 Jun 85
	5402	27°43'23"W	092°53'23"W	335 m	07 Jun 85
	5404	27°43'19"N	092°53'28"W	340 m	07 Jun 85
	5406	27°43'17"N	092°53'17"W	336 m	07 Jun 85
WC3	5413	27°35'34"N	092°21'42"W	750 m	08 Jun 85
	5417	27°35'35"N	092°21'42"W	750 m	08 Jun 85
	5418	27°35'37"N	092°21'46"W	750 m	08 Jun 85
WC4	5419/5420	27°43'28"N	092°08'08"W	545 m	09 Jun 85
	5423/5424	27°43'32"N	092°07'57"W	547 m	09 Jun 85
WC6	5431/5432	27°42'43"N	091°33'02"W	580 m	10 Jun 85
	5433	27°42'46"N	091°32'58"W	556 m	10 Jun 85
	5434	27°42'43"N	091°32'57"W	554 m	11 Jun 85
WC7	5442	27°45'39"N	091°13'11"W	454 m	12 Jun 85
WC8	5443/5444	27°50'30"N	090°44'07"W	545 m	13 Jun 85
	5445/5446	27°50'23"N	090°44'01"W	550 m	13 Jun 85
	5447/5448	27°50'29"N	090°44'06"W	547 m	13 Jun 85
WC9	5450	27°41'37"N	091°17'53"W	753 m	11 Jun 85
	5454	27°41'32"N	091°17'51"W	761 m	11 Jun 85
	5457/5458	27°45'17"N	090°47'38"W	748 m	12 Jun 85
WC10	5459	27°45'19"N	090°47'41"W	748 m	12 Jun 85
	5471	27°19'44"N	091°33'02"W	1235 m	13 Jun 85
Atlantic coast of Florida (ODMDS-study)					
3		25°46'00"N	080°03'22"W	196 m	Sep 85
4		25°45'15"N	080°03'22"W	183 m	Sep 85
6		25°45'00"N	080°03'46"W	183 m	Sep 85
7		25°45'00"N	080°02'58"W	235 m	Sep 85
8		25°44'00"N	080°03'22"W	190 m	Sep 85
9		25°43'00"N	080°03'22"W	175 m	Sep 85

sample 4445; 1 neuter, USNM 232795, Sta. E2B-2, sample 4446; 1 female + 1 manca-II, Sieg Coll., 1 female, USNM 232798, Sta. E2B-4, sample 4448; 2 neuters + 2 manca-I, USNM 23279, Sta. E2B-5, sample 4449; 1 neuter + 1 manca-II, USNM 232792, Sta. E2B-6, sample 4450; 1 female + 1 neuter, USNM 232789, Sta. E2-1, sample 4451; 1 female + 1 neuter + 1 manca-II, USNM 232807, Sta. E2-2, sample 4452; 1 neuter + 1 manca-I, USNM 232810, Sta. E2-3, sample 4453; 2 females, Sieg Coll., Sta. E2-4, sample 4454; 1 female, USNM 232806, Sta. E2-5, sample 4455; 1 female + 3 neuters + 2 manca-II, USNM 232805, Sta. E2-6, sample 4456; 2 females, USNM 232791, Sta. E2C-1, sample 4457; 2 neuters, USNM 232800, Sta. E2C-2, sample 4458; 1 female + 2 neuters, USNM 232793, Sta. E2C-5, sample 4461; 1 female, dried, USNM 232825, Sta. E2D-1, sample 4463; 1 neuter, dried, USNM 232834, Sta. E2D-3, sample 4465; 1 manca-I, dried, USNM 232827, Sta. E2D-5, sample 4467; 1 neuter + 1 manca-I, dried, USNM 232828, Sta. E2E-1, sample 4470; 4 neuters + 2 manca-I, USNM 232832, Sta. E2E-3, sample 4471; 1 female, USNM 232836, Sta. E2E-4, sample 4472; 1 female + 1 neuter, USNM 232830, Sta. E2E-5, sample 4473; 1 female + 2 neuters, USNM 232829, Sta. E2E-5, sample 4474; 1 neuter, USNM 232822, Sta. E3A-4, sample 4478; 1 neuter, USNM 232818, Sta. E3A-6, sample 4480; 2 manca-II, dried, USNM 232835, Sta. E3-4, sample 4484; 1 neuter, USNM 232821, Sta. E3-6, sample 4486; 1 neuter, USNM 232819, Sta. E3B-3, sample 4489.

West central transect, off Louisiana, cruise V, boxcore samples; 1 neuter, USNM 232848, Sta. WC1-1, sample 5401; 2 neuters, USNM 232845, Sta. WC1-2, sample 5402; 1 neuter + 1 manca-I, USNM 232851, Sta. WC1-4, sample 5404; 1 neuter, USNM 232850, Sta. WC1-6, sample 5406; 1 female + 1 neuter + 1 manca-II, USNM 232854, Sta. WC4-1, sample 5419; 1 neuter, USNM 232852, Sta. WC4-2, sample 5420; 1 neuter + 1 manca-II, USNM 232849, Sta. WC4-5, sample 5423; 1 female, USNM 232842, Sta. WC4-6, sample 5424; 1 neuter, USNM 232853, Sta. WC6-1, sample 5431; 1 neuter + 1 manca-I, USNM 232844, Sta. WC6-2, sample 5432; 1 female + 1 manca-I, USNM 232843, Sta. WC6-3, sample 5433; 2 manca-I, USNM 232855, Sta. WC6-4, sample 5434; 2 neuters, USNM 232846, Sta. WC7-6, sample 5442; 2 females, Sieg Coll., Sta. WC8-1, sample 5443; 2 manca-II, USNM 232847, Sta. WC8-3, sample 5445; 1 neuter, USNM 232841, Sta. WC8-4, sample 5446.

Western transect, off Texas, cruise II, boxcore samples; 1 female, USNM 232826, Sta. W2-13, sample 2025; 1 manca-II, USNM 232840, Sta. W2-12, sample 2026; 1 female, Sieg Coll., Sta. W2-21, sample 2027; 1 neuter, USNM 232788, Sta. W2-31, sample 2039; 1 neuter, USNM 232838, Sta. W2-33, sample 2041; 1 neuter, damaged, USNM 232839, Sta. W3-11, sample 2067.

Northwestern Gulf of Mexico – [Texas hardbank study; mainly as *Typhlotanais* sp. A, see Texas A&M University, 1978].

West Flower Garden Bank, 27°52'N, 093°50'W, depth 24–98 m; 1 female, Sta. I-6-1, 13 Oct. 1981, Invertebrate Zoology Collection of the Gulf Coast Research Laboratory Museum; 1 female, Sta. VI-3-1, 19 May 1982; 1 neuter, Sta. I-4-1, 13 Oct. 1980; 1 female, Sta. V-4-2, 8 Nov. 1981, Sieg Coll.

East Flower Garden Bank, 27°53'N, 093°38'W, about 100 m depth; 1 female Sta. III-5-1, 2 Apr. 1981. 1 female (damaged), Sta. III-5-4, 3 Apr. 1981; 1 female, Sta. VI-3-1, 23 May 1982.

Exact location unknown; 1 neuter, CNA Sta. I-1-3, 11 Oct. 1980; 1 female, CNA Sta. I-1-5, 11 Oct. 1980.

Type-locality

Western North Atlantic, off South Carolina, 32°50'N, 079°04'W, 22 m.

Etymology

The name indicates that this species, contrary to the type-species, *Mesotanais dubius* Dollfus, 1897, occurs in relatively shallow waters (Latin: *vadum* = shallow water and *-cola* = dweller, inhabitant).

Description of female (paratype)

Length of adult female about 4 mm, 6.6 times longer than broad (Figure 1).

Cephalothorax – Elongate, 1.3 times longer than broad; no eye-lobes and no visual elements. Slightly narrowed anteriorly, one setule at midlength and one setule close to anterior corner.

Peraeonites – Lateral margins of all peraenites slightly convex in dorsal view, no setae. First peraenite 2.1 times broader than long, broadest anteriorly. Second to fifth very similar, about 1.3 times broader than long, second to fourth broadest at midlength, fifth broadest in posterior third. Sixth 2.1 times broader than long, trapezoidal.

Pleon – All five pleonites of similar size, small, about six times broader than long.

Antenna 1 (Figure 1) – Probably 4-segmented. First segment elongate, 4.8 times longer than broad; inner border with 3 feathered hairs and one seta at midlength and 2 feathered hairs and one seta distally; outer border with one seta at midlength. Second segment short, only 1.4 times longer than broad, outer distal border with one feathered hair and one seta. Third nearly 3.6 times longer than broad, with 4 distal setae. Fourth (?) segment tiny, bearing one aesthetasc and 3 setae (fourth "segment" might be interpreted as a protuberance of the third).

Antenna 2 (Figure 1) – 6-segmented. First segment small, hemispherical, partly fused with cephalothorax,

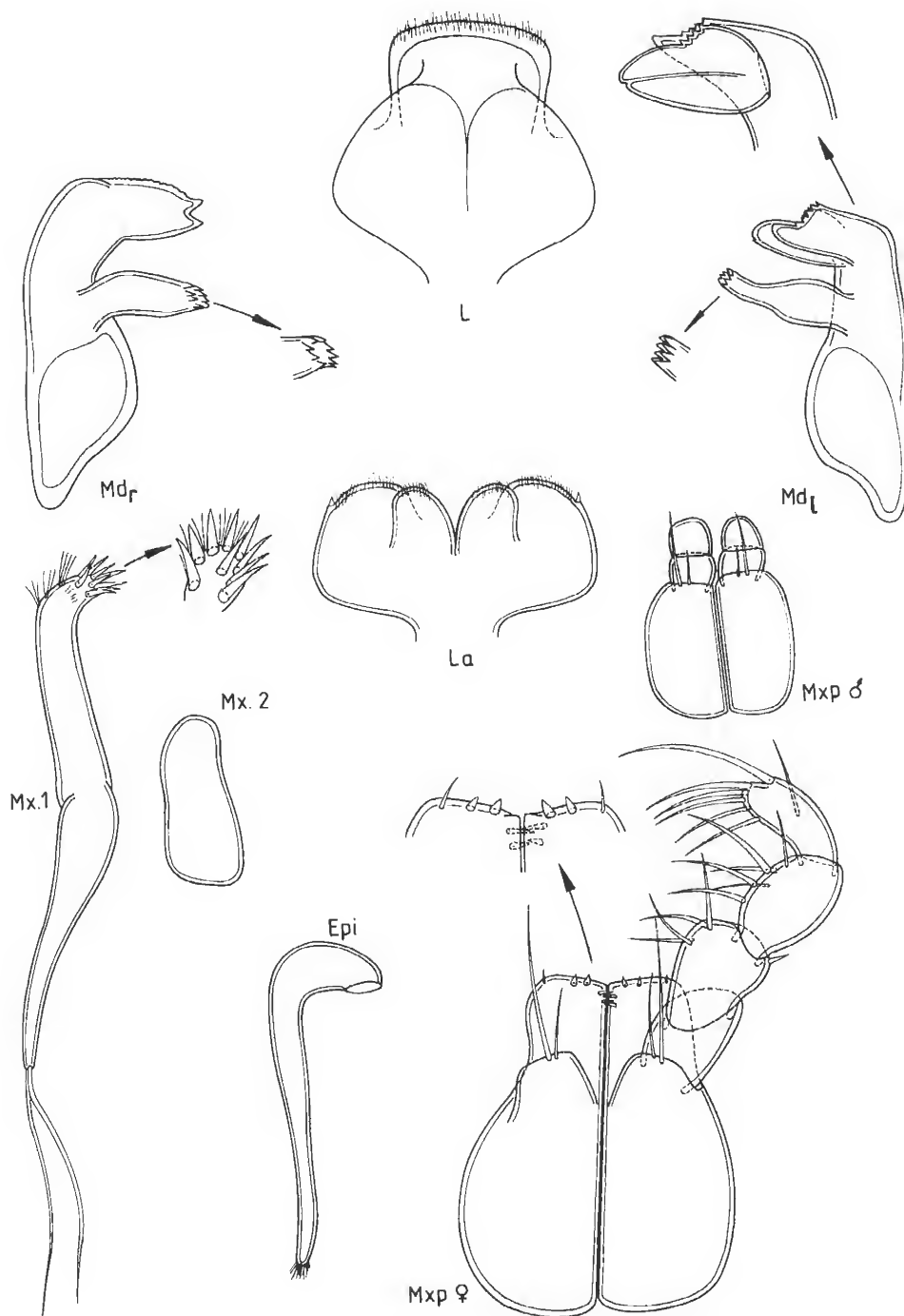


Figure 2. *Mesotanaïs vadicola* sp. nov., female paratype and maxilliped of the male.

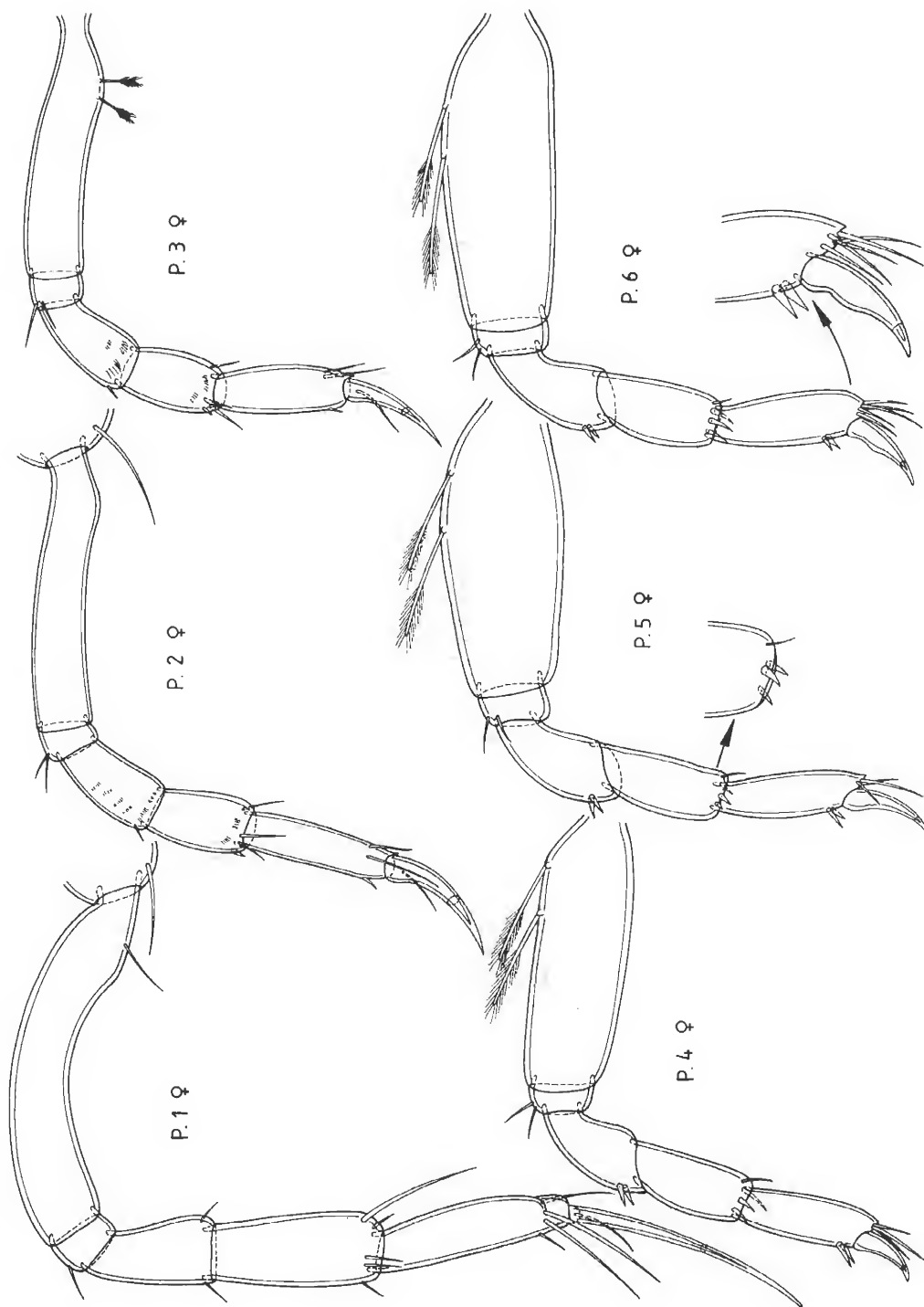


Figure 3. *Mesotanais vadicola* sp. nov., female paratype.

and unarmed. Second short, 1.6 times longer than broad, distal outer border ending in a spine-like process, one seta proximal to it; inner border with one small distal seta. Third stout, as long as broad, only outer border with one seta. Fourth elongate, slightly bent ventrally, 6.1 times longer than broad, proximal third with one feathered hair and one seta, distally with 2 feathered hairs and 3 setae. Fifth also elongate, but only 4.5 times longer than broad, with one feathered hair and 2 setae distally. Sixth very small, conical, with one short and 5 longer setae.

Labrum (Figure 2) – Hood-shaped, tip covered with fine setules.

Mandibles (Figure 2) – Well developed and of typical shape. Pars molaris reduced compared to other members of family, but still well developed; crushing area relatively small, surrounding wall covered with a circle of small teeth. Right mandible with slightly crenulate pars incisiva, lacinia mobilis fused, represented only by a tip. Pars incisiva of left mandible with one large and 4 small teeth; lacinia mobilis large, with one large slightly indented tooth and 4 small teeth.

Labium (Figure 2) – Consisting of 2 lobes; inner lobe small, tip covered with fine setules; outer lobe well developed, covered with fine setules, distal edge with a spine-like structure.

Maxilla 1 (Figure 2) – Endite bearing circle of 8 spines and with one additional spine at center, spines accompanied by several groups of small setae. Palp one-segmented as long as endite, with 2 terminal setae.

Maxilla 2 (Figure 2) – Of typical shape, pear-shaped, lacking setae.

Maxilliped (Figure 2) – Well developed, without coxae. Basis unfused medially, with one long and one shorter setae near articulation of palpus; inner lobes slightly smaller than in other members of the family, unfused, distal margins each with 2 translucent spines near midline, outer edges each with a setule, 2 pairs of coupling-hooks. Palpus 4-segmented; first segment triangular, inner border shorter than outer; second with inner border longer than outer, 1 distal spine-like seta at outer border, inner border with 2 groups each with 2 setae; third segment nearly 1.6 times longer than broad, inner border with 6 setae; fourth about twice as long as broad, outer border with 1 seta, inner border with 6 distal setae.

Epignath (Figure 2) – Of typical shape; elongate, tip rounded and covered with fine setules.

Cheliped (Figure 1) – Well developed, of typical shape. Side-piece of normal size, articulating with basis behind a distal conjunction. Basis elongate, 1.9 times longer than broad. Merus small, triangular, with 1 long and 1 short midsternal seta. Carpus 3.2x as long as broad, outer border with one small proximal and one small distal seta; inner border with 1 small and 2 long distal setae. Propodus with stout fixed finger, twice as long as broad, with "comb" close to base of dactylus

consisting of 2 small setae and a group of fine setules; 1 additional small seta nearby; fixed finger with 3 tergal and 2 sternal setae, tip represented by a thorn-like projection. Dactylus curved, tip only somewhat more sclerotized than rest, as long as fixed finger.

Peraeopod 1 (Figure 3) – Slender, longer than P.2 - P.3. Coxa not fused with peraeonite, with 1 seta. Basis bent sternally, 5.7 times longer than broad, proximal with 1 sternal seta. Ischium annular, with 1 tergal seta. Merus 1.6 times longer than broad, tergal and sternal border each with 1 distal seta. Carpus about 2.4 times longer than broad, tergal border with 3 distal and sternal border with 2 distal setae. Propodus 3.6 times longer than broad, tergal border with one small distal seta, sternal border with 3 long distal setae. Dactylus and terminal spine unfused, combined about 1.4 times longer than propodus, dactylus with one proximal seta.

Peraeopod 2 (Figure 3) – Shorter than P.1. Coxa not fused with peraeonite, bearing one seta. Basis nearly 4.8 times longer than broad, no setae. Ischium annular, with 2 tergal setae. Merus 1.7 times longer than broad, tergal border with one distal seta, covered with several groups of fine setules. Carpus 1.6 times longer than broad, tergal border distally with one tiny spine as well as 2 setae and sternal border distally with one seta, 2 groups of setules. Propodus 3.5 times longer than broad, tergal border with 1 tiny distal spine, sternal border with 2 distal setae. Propodus and terminal spine unfused, together shorter than propodus, dactylus with 1 seta.

Peraeopod 3 (Figure 3) – Similar to P.2, but basis and propodus somewhat shorter; basis also with 2 feathered hairs sternally.

Peraeopod 4 (Figure 3) – Stout. Coxa fused with peraeonite, no setae. Basis three times longer than broad tergal border with two proximal feathered hairs. Ischium annular, 2 tergal setae. Merus bent sternally, 1.6 times longer than broad, tergal border with one rostral and one caudal spine. Carpus twice as long as broad, distal border sternally with one spine as well as one seta and tergally with two spines. Propodus 2.6 times longer than broad, tergal border with distally one caudal and one rostral spine, sternal border with 3 distal setae. Dactylus and terminal spine fused, forming a claw.

Peraeopod 5 (Figure 3) – Similar to P.4, but basis somewhat stronger.

Peraeopod 6 (Figure 3) – Similar to P.4 and P.5, except propodus bearing 5 distal setae on sternal border.

Pleopods (Figure 5) – All 5 pairs of pleopods similar. Basis small, as long as broad, sternal border with one pinnate seta. Exopodite one-segmented, outer border covered with pinnate setae, 1 strongly developed proximal pilose seta, one strong, pilose seta separated by a gap from the pinnate setae. Endopodite one-segmented, inner border with one pinnate seta at midlength; outer border with one proximal seta sepa-

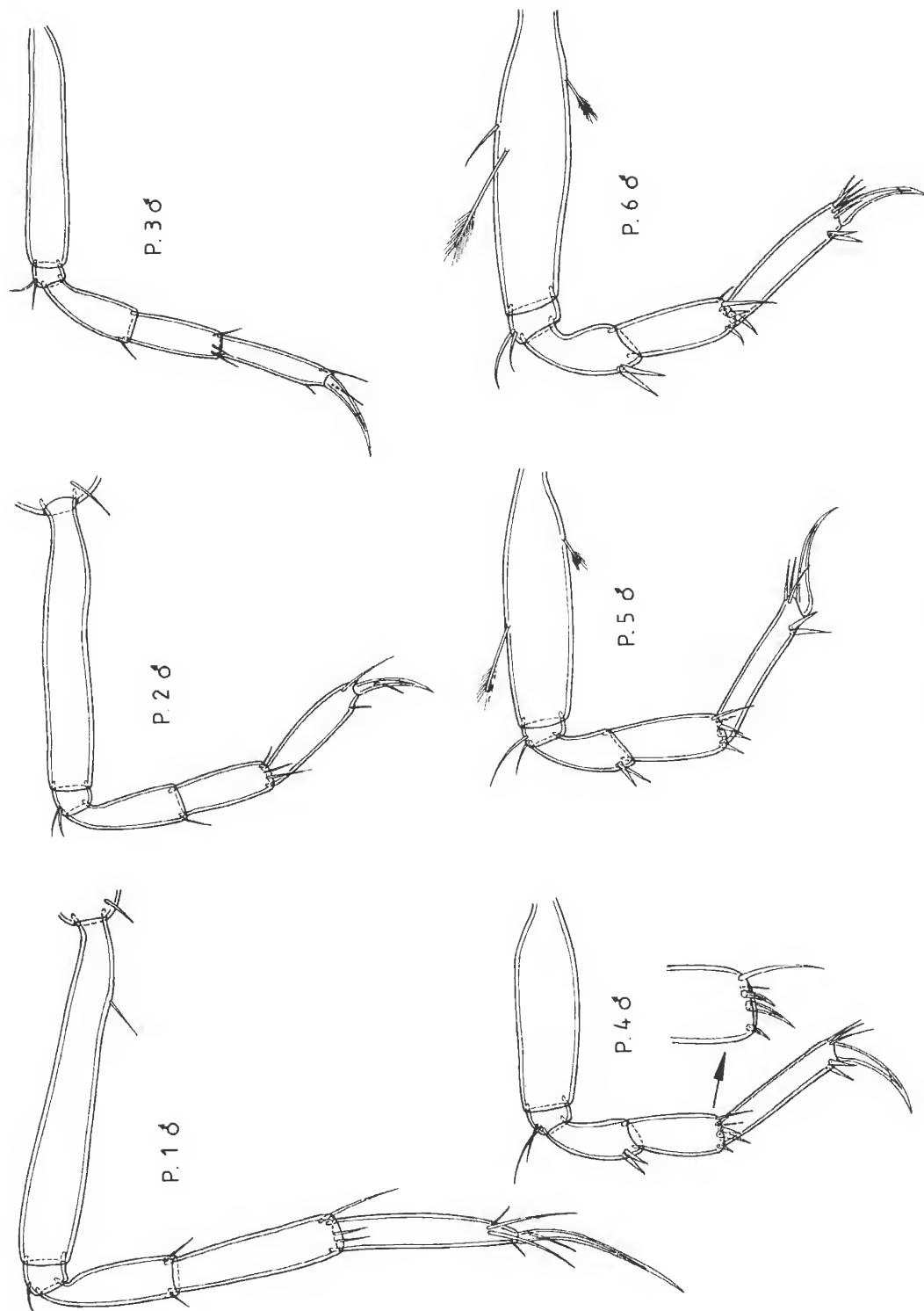


Figure 4. *Mesotanais vadicola* sp. nov., male.

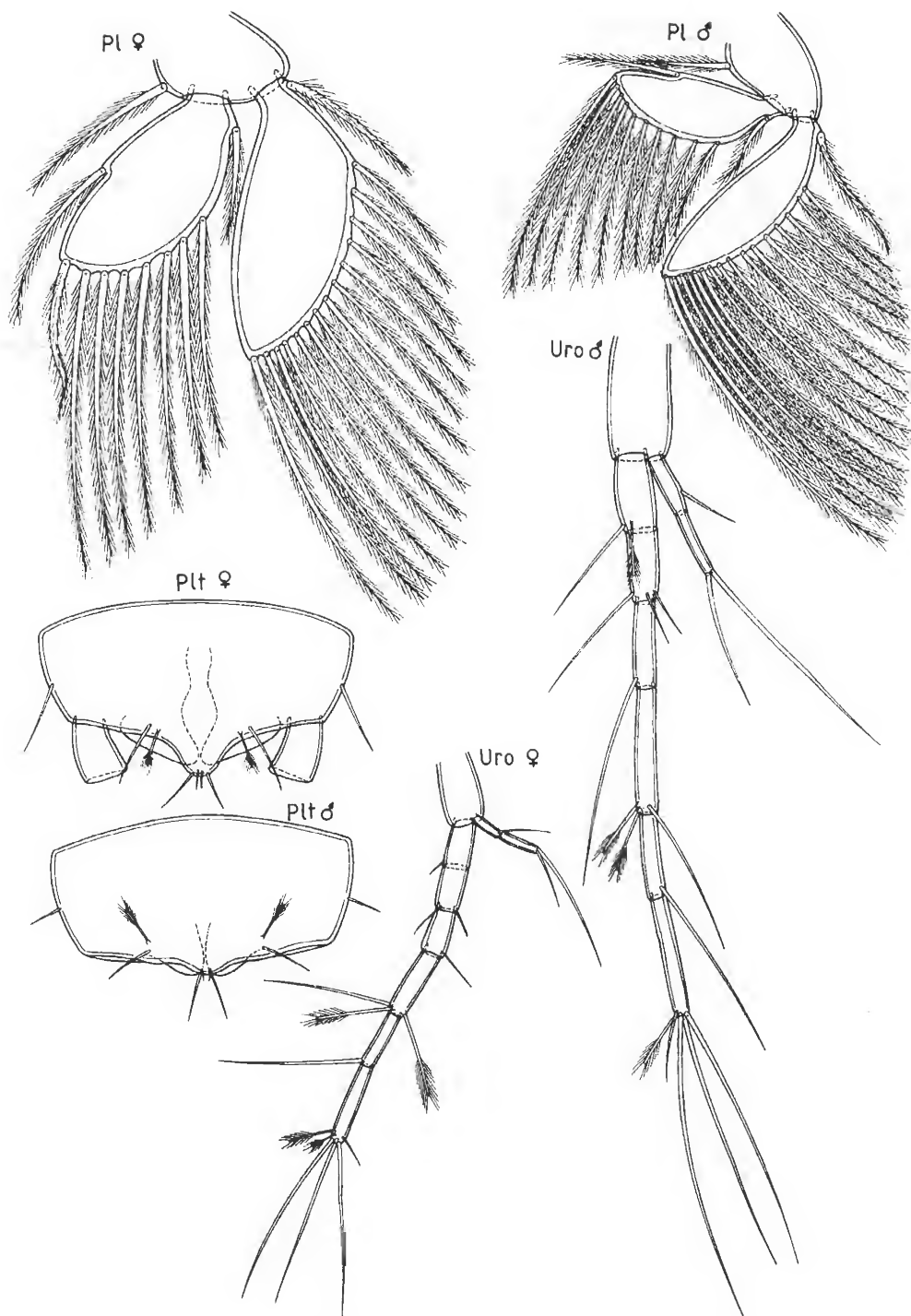


Figure 5. *Mesotanais vadicola* sp. nov., female paratype and male.

rated by gap from other pinnate setae.

Pleotelson (Figure 5) – Of typical shape, about twice as broad as long; caudal point prominent but typically bent sternally, with 2 tergal and 2 sternal setae; lateral borders each with one seta, caudal border with one seta and one feathered hair on each side of midline.

Uropods (Figure 5) – Biramous. Basis short, 1.7 times longer than broad, unarmed. Exopodite two-segmented; first segment about three times as long as broad, one distal seta; second similar to first, with two setae at tip. Endopodite five- or six-segmented; first and second segment fused, together about 3.1 times longer than broad, with one seta at midlength and two distal setae; third 1.7 times longer than broad, one distal seta; fourth 3.5 times longer than broad, 2 feathered hairs and one seta distally; fifth about 3.7 times longer than broad, one distal seta; sixth segment 5.2 times longer than broad, with 2 feathered hairs, one small and three long setae at tip.

Description of male

Length of adult male about 4.2 mm, about eight times longer than broad, different in body-shape to the female (Figure 1).

Cephalothorax – No eye-lobes or visual elements, elongate, 1.2 times longer than broad, broadest in posterior third, narrowed anteriorly, borders straight; with one anterior and one posterior setule.

Peraeonites – Proportions different to those of the female, more elongate. First with anterior border concave, nearly twice as broad as long. Second to fifth equal in shape, lateral borders straight; second to fourth as long as broad, fifth 1.1 times broader than long. Sixth trapezoidal, broadest posteriorly, 2.5 times broader than long.

Pleon – Well developed, all 5 pleonites of similar size, small, 4.5 times broader than long.

Antenna 1 (Figure 1) – Elongate, 7-segmented. First segment long, 5 times longer than broad, with three setae at midlength and inner border with 2 feathered hairs. Second 1.5 times longer than broad, with 2 distal setae and one distal feathered hair. Third 1.6 times longer as broad, with proximal and distal one group of 3 aesthetascs. Fourth 2.2 times longer than broad, with a distal group of four aesthetascs. Fifth twice as long as broad, with a distal group of 3 aesthetascs. Sixth 3.5 times longer than broad, with only one distal aesthetasc and 2 setae. Seventh segment tiny with one aesthetasc, 3 long and 2 short setae.

Antenna 2 (Figure 1) – Similar to that of the female, but with fourth segment more elongate, seven times longer than broad, suture near midlength with one feathered hair and on simple seta immediately adjacent to it, 4 feathered hairs and 2 setae distally.

Mouthparts – greatly reduced.

Maxilliped (Figure 2) – Represented by remnants. Basis unfused and with 2 setae near articulation of palpus; palpus represented by only 2 small bulge-like structures (the number of segments could not be determined exactly, because the Maxilliped was not removed from the cephalothorax).

Cheliped (damaged in only male available for study) (Figure 2) – Basis relatively short, unarmed. Merus and carpus fused, carpus extremely elongate, distal part broken off. Propodus and dactylus lacking.

Peraeopods 1-6 (Figure 4) – Similar to those of the female; only minor variations of setation are recognized; in general all pairs of legs are more slender, especially dactylus and terminal spine (which are fused in P.4- P.6) and are longer than in the female.

Pleopods (Figure 5) – As in female, but slightly smaller.

Uropods (Figure 5) – Similar to female, but more elongate, with minor differences in setation.

Pleotelson (Figure 5) – Also similar to that of the female, except caudal point which is not as prominent as in the female.

Remarks

The specimens examined show only minor variations in the setation of the appendages which are not considered of taxonomic importance. The number of segments in the uropodal endopodite vary from four (Manca-II) to seven (adult female). The correct number of segments in the first antenna could not be determined satisfactorily. In some specimens the tip appears to be represented by a minute segment while in others it seems to be separated only by a weak suture. Of interest is the terminally narrowed pars molaris and resultant reduction of the mandible's crushing area in *M. vadicola*. This condition differs from that in *M. longisetosus* and all other known leptocheliid species.

Additional characters distinguishing *M. vadicola* from *M. longisetosus* are discussed under the latter species.

Mesotanais vadicola appears to be most closely related to an eastern Atlantic species currently being described by Sieg and Bird, in press). *Mesotanais vadicola* and the new eastern Atlantic cognate are distinguished and discussed by these two authors.

Sexual dimorphism in *M. vadicola* is well developed. The male differs from the female not only in the antenna 1, mouthparts, and chelipeds, but also in body shape. The first two segments of the first antenna are fused to form a 2-segmented peduncle. The flagellum is 5-segmented with two groups of aesthetascs on the basal segment. The cephalothorax is somewhat more elongate than in the female. The remains of the maxilliped are similar to those in *Pseudoleptochelia* Lang, 1973. The chelipeds may resemble those of the *Leptochelia minuta* Dana, 1849 or *L. forresti* (Stebbing, 1896), but this can only be verified by the collection of additional specimens. Adult males may

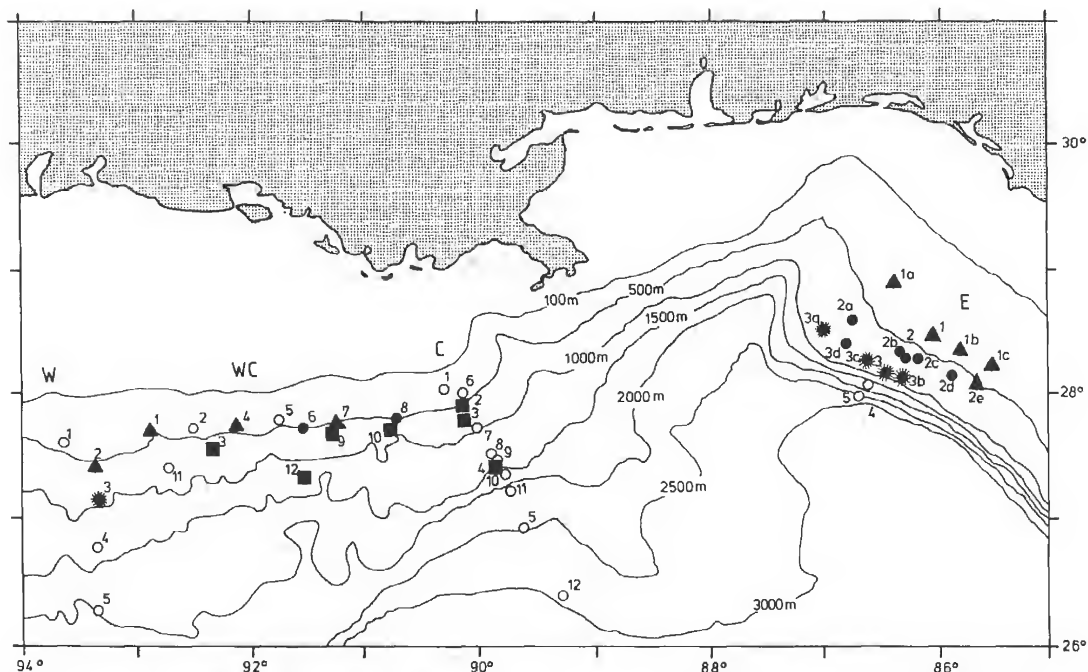


Figure 6. Station locations (NGOMCS) showing occurrence of *Mesotanais vadicola* and *M. longisetosus* on continental slope of the Northern Gulf of Mexico. Four transects are designated by: W = Western transect; WC = west central transect; C = central transect; E = eastern transect. ○ = *M. longisetosus* only. ● = *M. vadicola* only. ▲ = *M. longisetosus* and *M. vadicola* at same station, but in different replicates. ▲ = *M. longisetosus* and *M. vadicola* in same replicate.

not occur before July/August because the single male from off Florida was collected in September while those specimens from the Gulf of Mexico were collected in April, May or June.

Distribution (Figure 6, 11) – *Mesotanais vadicola* may have a broad distribution along the continental shelf of the eastern United States and the Gulf of Mexico. The specimens studied were collected from depths ranging between 22 m (Atlantic, off South Carolina) and 865 m (Gulf of Mexico, off Florida). Based on the data from the Gulf of Mexico, this species appears to inhabit the outer continental shelf and upper continental slope. In the latter area *M. vadicola* may be competing with *M. longisetosus* and is apparently replaced by this species with increasing depth.

Mesotanais longisetosus sp. nov

Figures 7-10, 6, 11

Type-material

[Mineral Management Service (MMS)/Northern Gulf of Mexico Continental slope (NGOMCS) study; for

station data details see Table I]: 1 female with empty marsupium, holotype, USNM 232858, Sta. C3-13, sample 197.

Paratypes – Central transect, off Louisiana, cruise I, boxcore samples; 1 female dissected, Sta. C3-23, sample 213; 1 manca-I; USNM 232867, Sta. C4-41, sample 363; cruise II, central transect, off Louisiana, 1 fragment (cephalothorax) + 1 neuter, USNM 232865, Sta. C2-11, sample 2169; 1 manca-I (damaged), USNM 232856, Sta. C2-21, sample 2176; 1 female, USNM 232862, Sta. C2-51, sample 2197; 1 female, USNM 232869, Sta. C3-11, sample 2211; 1 female + 1 fragment, USNM 232857, Sta. C3-21, sample 2218; 1 female (damaged), USNM 232861, Sta. C3-31, sample 2227; 1 female + 1 neuter, USNM 232864, Sta. C3-51; 1 neuter (damaged, USNM 232860; Sta. C3-61, sample 2248; 1 female (fragment), USNM 232859, Sta. C3-62, sample 2249; 1 manca-I, USNM 232863, Sta. C4-52, sample 2287; 1 manca-I, USNM 232866, Sta. C4-63, sample 2295.

Additional material

Same study (MMS/NGOMCS), central transect, off Louisiana, cruise III, boxcore samples; 1 manca-I,

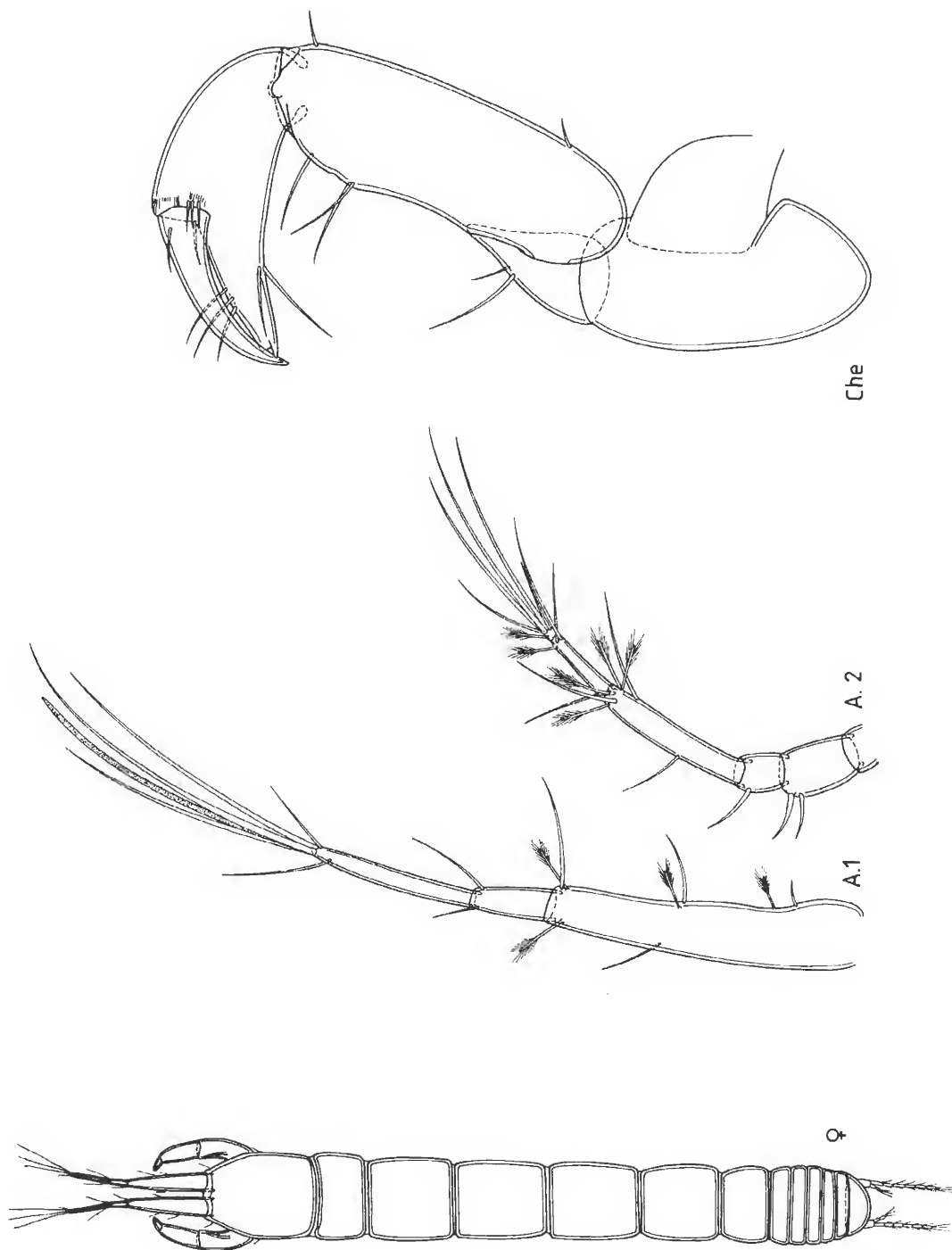


Figure 7. *Mesotanaeis longisetosus*, female paratype.

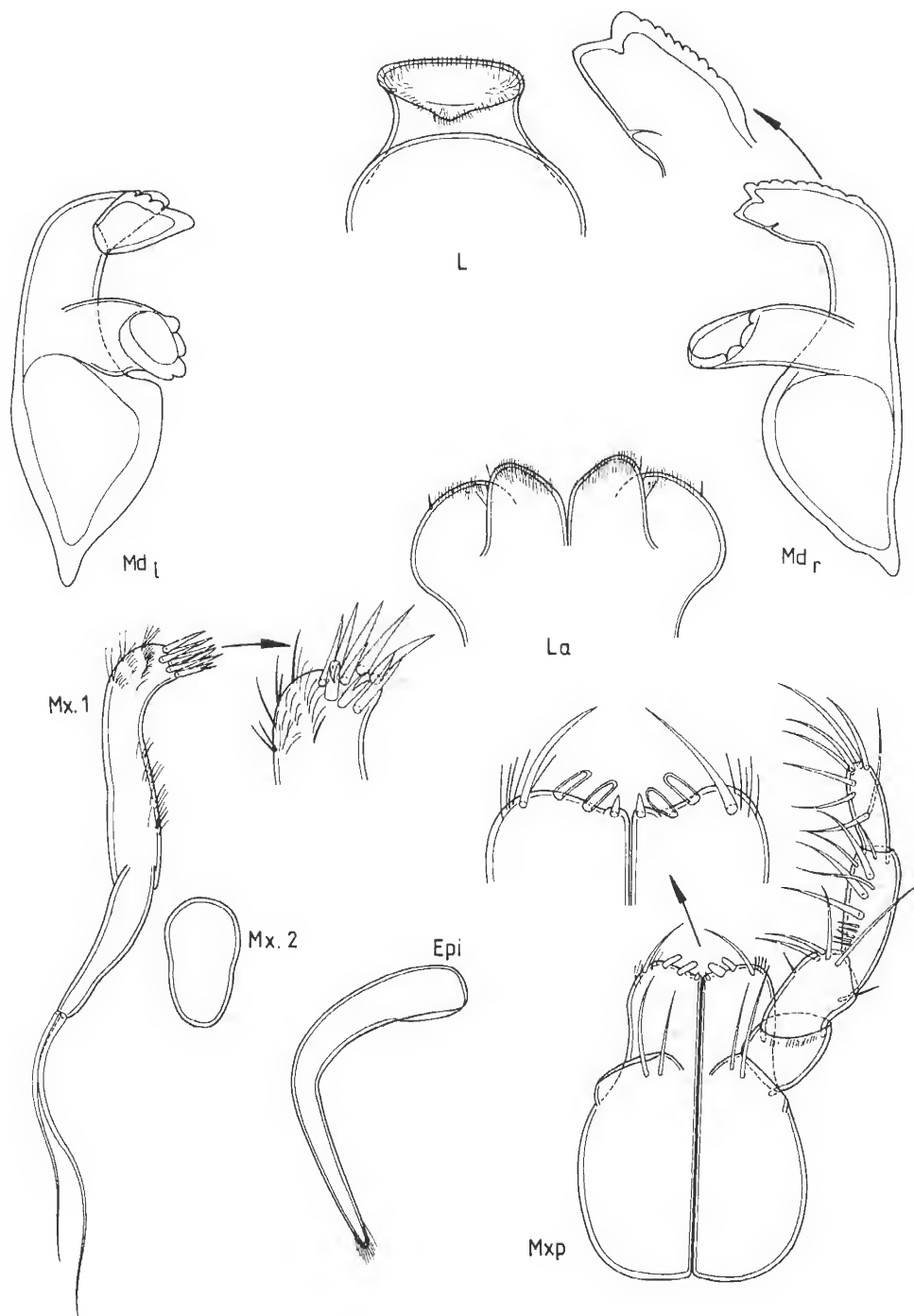


Figure 8. *Mesotanais longisetosus*, female paratype.

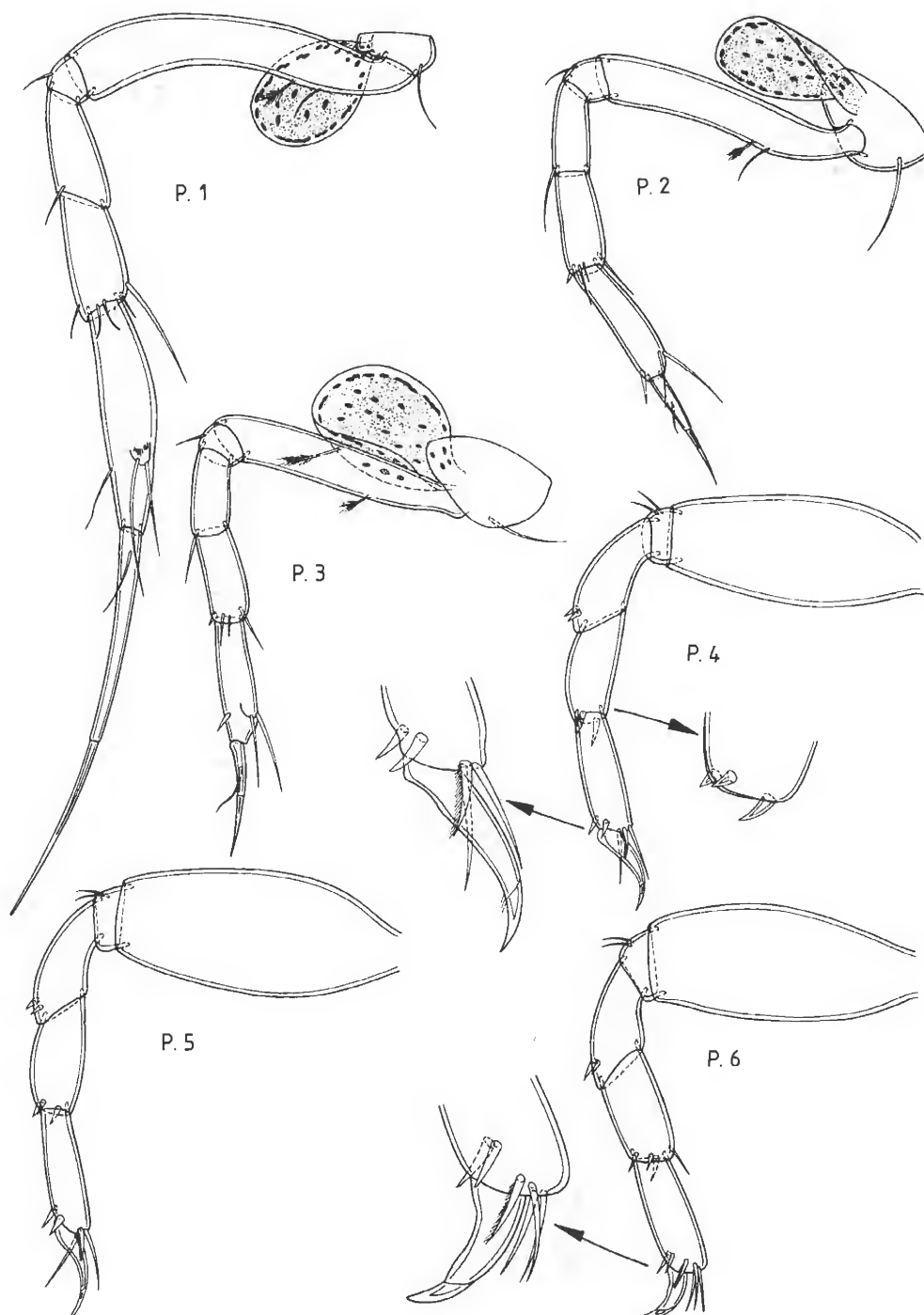


Figure 9. *Mesotanais longisetosus*, female paratype.

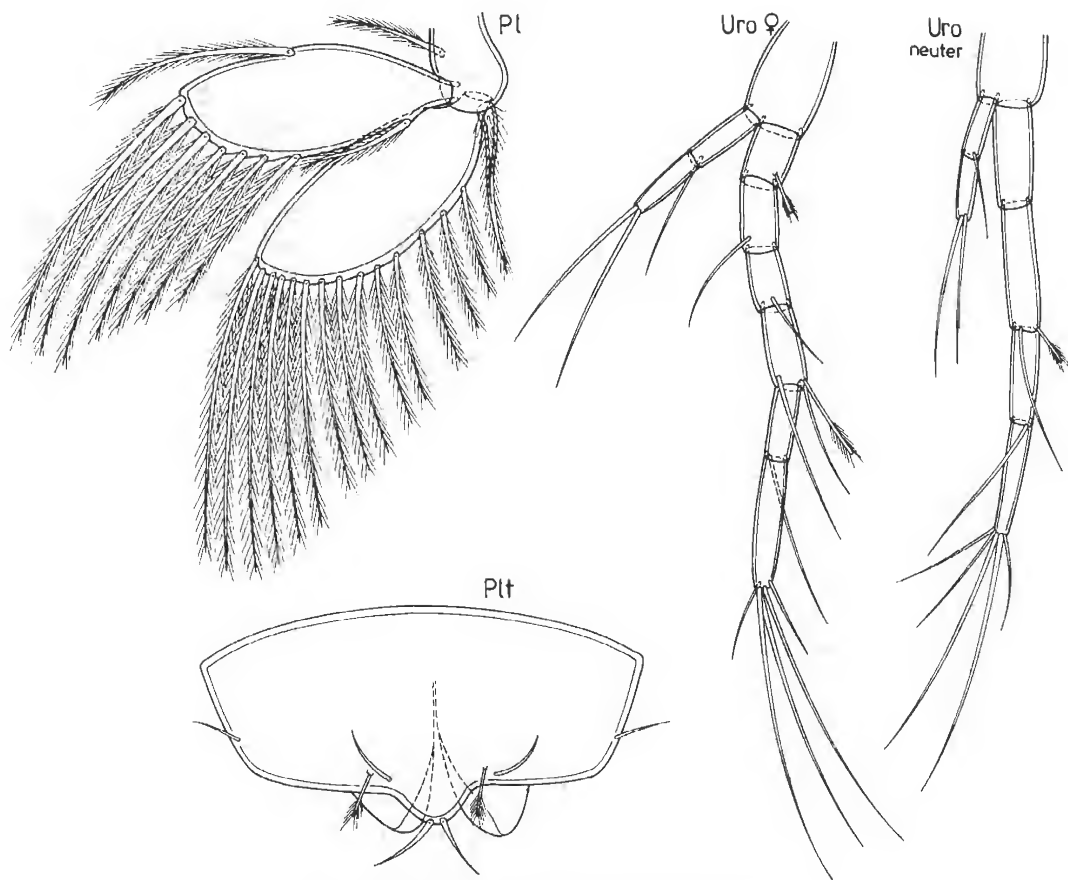


Figure 10. *Mesotanais longisetosus*, female paratype.

USNM 232868, Sta. C3-4, sample 3016.

Same study, western transect, off Texas, cruise II, boxcore samples; 2 manca-I, USNM 232870, Sta. W3-21, sample 2070.

Same study, western-central transect, off Louisiana, cruise V, boxcore samples; 1 neuter (fragments) + 1 manca-I, USNM 232881, Sta. WC3-1, sample 5413; 1 neuter, USNM 232877, Sta. WC3-5, sample 5417; 1 neuter, USNM 232875, Sta. WC3-6, sample 5418; 2 females, USNM 232884, Sta. WC6-1, sample 5431; 1 neuter (dried), USNM 232876, Sta. WC8-1, samples 5443; 1 neuter, lost, Sta. WC8-2, sample 5444; 1 manca-II, USNM 232880, Sta. WC8-4, sample 5446; 1 neuter + 1 manca-I, USNM 232878, Sta. WC8-5, sample 5447; 1 neuter, USNM 232879, Sta. WC8-6, sample 5448; 1 neuter, USNM 232874, Sta. WC9-2, sample 5450; 1 neuter (dried), USNM 232871, Sta. WC9-6, sample 5454; 1 female + 1 manca-I, USNM 232872, Sta. WC10-3, sample 5457; 1 manca-II,

USNM 232882, Sta. WC10-4, sample 5458, 1 manca-II, USNM 232883, Sta. WC10-5, sample 5459; 2 neuters, USNM 232873, Sta. WC12-5, sample 5471.

Same study, eastern transect, off Florida, cruise II, boxcore samples; 1 neuter + 2 manca-I, USNM 232885, Sta. E3-31, sample 2402; 1 neuter, dissected, Sieg Coll., Sta. E3-33, sample 2404; 1 female (dried), USNM 232890, Sta. E4-42, sample 2461; cruise IV, boxcore samples; 3 neuters (dried), USNM 232911, 2 manca-I, USNM 232888, Sta. E3D-3, sample 4427; 1 neuter, USNM 232893, Sta. E3C-3, sample 4433; 1 manca-I, USNM 232899, Sta. E2A-6, sample 4444; 1 neuter, USNM 232900, Sta. E2B-2, sample 4446; 1 manca-I + 1 manca-II (both dried), USNM 232964, Sta. E2-2, sample 4452; 1 neuter (dried), USNM 232908, Sta. E2-5, sample 4455; 1 manca-I, USNM 232895, Sta. E2-6, sample 4456; 1 neuter, USNM 232897, Sta. E2C-3, sample 4459; 1 neuter, USNM 232902, Sta. E2C-6, sample 4462; 2 females, USNM

232903, 1 neuter (dried); USNM 232891, Sta. E2D-1, sample 4463; 1 neuter + 1 manca-I (both dried), USNM 232909, Sta. E2D-3, sample 4465; 1 manca-II, USNM 232986, Sta. E2D-4, sample 4466; 1 manca-I (dried), USNM 232901, Sta. E2D-5, sample 4467; 1 neuter + 1 manca-I (both dried), USNM 232907, Sta. E2D-6, sample 4468; 1 manca-I + 1 manca-II (both dried), USNM 232894, Sta. E3A-1, sample 4475; 1 neuter (dried), USNM 232910, Sta. E3A-5, sample 4479; 1 neuter, USNM 232898, Sta. E3-1, sample 4481; 1 neuter, USNM 232905, Sta. E3-3, sample 4483; 1 neuter, USNM 232892, Sta. E3B-1, sample 4487; 1 neuter, USNM 232906, Sta. E3B-2, sample 4488; neuter, USNM 232886, Sta. E3B-4, sample 4490; 1 neuter, USNM 232889, Sta. E3B-5, sample 4491; 2 neuters, USNM 232887, Sta. E3B-6, sample 4492.

Type-locality

Gulf of Mexico, off Louisiana, Sta. C3, 27°49'12"N, 090°07'12"W, 845 m.

Etymology

The name refers to the long setae on antenna 1 and antenna 2 (Latin: *longus* = long and *setosus* = with setae).

Description of female (paratype)

Length of adult female reaching about 3.5 mm, more elongate than *M. vadicola*, 8.2 times longer than broad (Figure 7).

Cephalothorax – Elongate, 1.3 times longer than broad, posterolateral borders straight, not curved, anterior part narrowed, borders also straight, rostrum tiny, no eye-lobes or visual elements; one setule on each side near anterior comers and another at mid-length.

Peraeonites – Lateral margins of peraeonites 1–4 nearly straight, those of peraeonites 5–6 only convex. First with anterior margin concave, nearly 1.9 times broader than long. Second as long as broad, third and fourth about 1.15 times longer than broad. Fifth as long as broad. Sixth 1.6 times broader than long, broadest posteriorly.

Pleon – All 5 pleonites of similar size, small, about 5 times broader than long.

Antenna 1 (Figure 7) – Slender, 3-segmented. First segment 5.2 times longer than broad; inner border each with one feathered hair and one seta in the proximal third, at midlength, and distally; outer border with one seta at midlength and one distal feathered hair. Second segment 2.4 times longer than broad, with two distal setae. Third segment elongate, 8.5 times longer than broad, one subdistal seta, one small seta as well as 3 long setae and one aesthetasc at tip (long setae and

aesthetasc attached to small socle resembling minute fourth joint).

Antenna 2 (Figure 7) – Six-segmented. First segment small hemispherical, partly fused with cephalothorax, and unarmed. Second about 1.3 times longer than broad, outer distal border, with one strong and one normal seta. Third segment small, as long as broad, outer border with one distal seta. Fourth elongate, 6 times longer than broad, one seta at midlength, distally with a circle of 4 feathered hairs and three setae. Fifth segment 4.5 times longer than broad, distally with 1 feathered hair and 2 setae. Sixth segment small, conical, with one feathered hair, 2 short, and 3 long setae.

Labrum (Figure 8) – Hood-shaped, tip covered with fine setules.

Mandibles (Figure 8) – Well developed and of typical leptocheliid shape. Pars molaris of typical shape, crushing area broad, wall indented 3 to 4 times. Right mandible with slightly crenulate pars incisiva, lacinia mobilis fused, represented only by pointed process. Pars incisiva of left mandible with 1 large and 2 small teeth, lacinia mobilis well developed, with one large and 3 small teeth.

Labium (Figure 8) – Consisting of 2 lobes; inner lobe small, tip covered with fine setules; outer lobe well developed, covered with fine setules, distal edge with a tiny spine-like structure.

Maxilla 1 (Figure 8) – Endite bearing circle of 8 spines, 1 bifid and with 1 additional spine at center; spines accompanied by several groups of small setae; proximal region also with several groups of setules. One-segmented palp as long as endite, with 2 terminal setae.

Maxilla 2 (Figure 8) – Of typical shape, pearshaped, lacking setae.

Maxilliped (Figure 8) – Well developed, without coxae. Basis unfused medially, with 2 setae near articulation of palpus; inner lobes (endites) slightly smaller than usual, unfused, each distal margin with 1 small and 2 large translucent spines close to midline. Palpus 4-segmented; first segment triangular, inner border shorter than outer, without setae; second segment with inner border longer than outer, inner border distal with 1 small and 4 longer setae, outer border with 1 distal seta; third segment elongate, about 2.5 times longer than broad, proximal part of inner border with 5 setules in a row, upper half with row of 3 strong seta flanked by 3 small setae; fourth segment 2.5 times longer than broad, outer border with 1 and inner border with 7 setae.

Epignath (Figure 8) – Of typical shape; elongate, tip rounded and covered with fine setules.

Cheliped (Figure 7) – Well developed, of typical shape. Side-piece of normal size, articulating with basis behind a distal conjunction. Basis elongate, twice as long as broad, no setae. Merus small, triangular, with one long and one short midsternal seta. Carpus elon-

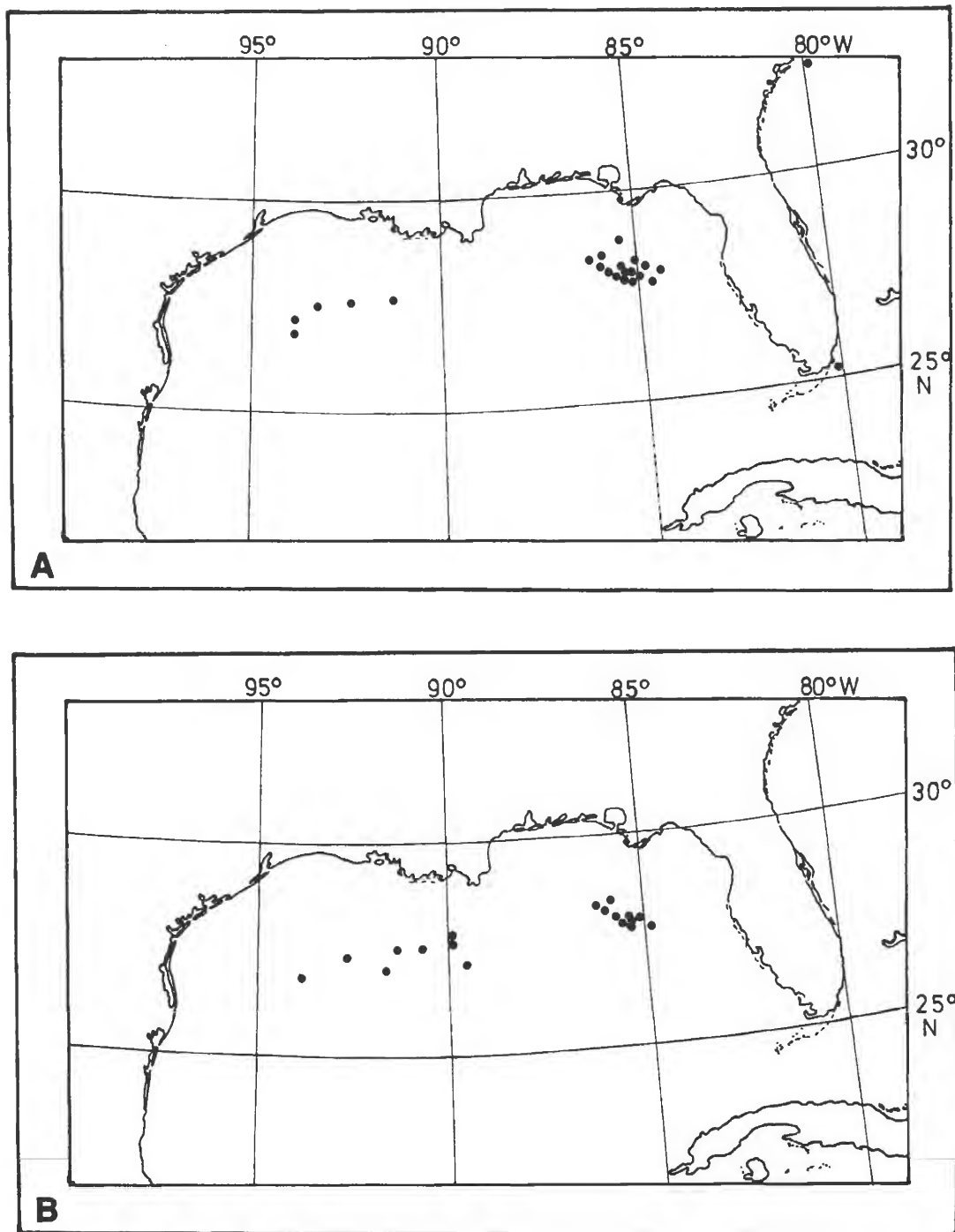


Figure 11. Distribution of the *Mesotanais* species: (A) *M. vadicola*, (B) *M. longisetosus*.

gate, 2.9 times longer than broad, tergal border with one small proximal and one small distal seta, distal third of sternal border with 3 setae. Propodus with fixed finger about 2.6 times longer than broad, sternal border of fixed finger with 2 setae and tergal border with three, tip not markedly sclerotized, "comb" consisting of three small setae and several groups of setules, caudally with 1 additional small seta near articulation of dactylus. Dactylus curved, as long as fixed finger, with 1 proximal seta.

Peraeopod 1 (Figure 9) – Slender, distinctly longer than P.2 and P.3. Coxa not fused with peraeonite, bearing a rudimentary oostegite and one seta. Basis bent sternally, 5.6 times longer than broad, proximal third of sternal border with one seta and one feathered hair. Ischium small, annular, one tergal seta. Merus nearly twice as long as broad, tergal border with one distal seta. Carpus 1.9 times longer than broad, distally with circle of 4 small setae and one long sternal seta. Propodus 4.2 times longer than broad, tergal border with one seta in distal third; sternal border with two long setae on a socle in distal third. Dactylus and terminal spine unfused, together about 1.8 times longer than propodus, dactylus with one proximal seta.

Peraeopod 2 (Figure 9) – Similar to P.1 but smaller. Coxa not fused with the peraeonite, bearing a rudimentary oostegite and one seta. Basis 5.4 times longer than broad, proximal third of sternal border with one seta and one feathered hair. Ischium annular, one tergal seta. Merus twice as long as broad, tergal border with one seta. Carpus 2.2 times longer than broad; tergal border with one caudal spine and two rostral setae; sternal border with one distal seta. Propodus 3.6 times longer than broad; tergal border with one subdistal spine; sternal border with two setae on a small socle. Dactylus and terminal spine unfused, short, as long as propodus, dactylus with one proximal seta.

Peraeopod 3 (Figure 9) – Similar to P.2, but basis with two feathered hairs, and propodus only with one long seta on socle in distal third.

Peraeopod 4 (Figure 9) – Stout. Coxa fused with peraeonite, bearing a rudimentary oostegite, no setae. Basis thickened, 2.2 times longer than broad, no setae. Ischium small, annular, two tergal setae. Merus bent sternally, tergal border distal with 1 caudal and 1 rostral spine. Carpus 1.7 times longer than broad, distal border with 1 rostral and 2 caudal spines. Propodus 2.9 times longer than broad; tergal border distally with one caudal and one rostral spine; sternal border with 1 caudal seta, and rostral border with 1 seta and 1 ciliated spine. Dactylus and terminal spine fused, forming a claw, which is shorter than propodus.

Peraeopod 5 (Figure 9) – Nearly identical to P.4.

Peraeopod 6 (Figure 9) – Similar to P.4 and P.5, except propodus bearing 3 setae on sternal border.

Pleopods (Figure 10) – All five pairs of pleopods similar. Basis small, as long as broad, sternal border with one pinnate seta. Exopodite one-segmented, outer

border covered with pinnate setae, close to articulation with basis 1 strong, pilose seta separated by a gap from the pinnate setae. Endopodite one-segmented, inner border with 1 pinnate seta at midlength; outer border with 1 proximal seta separated by a gap from the other pinnate setae.

Pleotelson (Figure 10) – Of typical leptocheliid shape, 2.1 times broader than long; caudal point prominent, but typically bent sternally, with 2 setae; lateral borders each with 1 seta, caudal border with 1 seta and 1 feathered hair on each side of midline.

Uropods (Figure 10) – Biramous. Basis short, 1.5 times longer than broad, unarmed. Exopodite 2-segmented; first segment about three times as long as broad, 1 distal seta; second similar to first, with 2 setae at tip. Endopodite 6-segmented, first segment 1.5 times longer than broad, with 1 feathered hair; second nearly twice as long as broad, with 1 distal seta; third 1.5 times longer than broad, with 1 seta; fourth segment twice as long as broad, with distal 2 setae and 1 feathered hair; fifth also twice times as long as broad, with 1 seta; sixth elongate, 4.6 times longer than broad, with 2 small and 3 long setae at tip.

Remarks

Mesotanais longisetosus superficially resembles members of the family Typhlotanaisidae, but as discussed above, this species shares most of the characters, especially the long terminal setae on the antenna, with *Mesotanais dubius* Dollfus, 1897, which as only recently been rediscovered and is being redescribed (Sieg and Bird, in press). It differs from *M. dubius* by having an elongate distal seta on the carpus and a more styliform dactylus of the first peraeopod, and by the presence of two short, disto-tergal spines on the merus peraeopods 4–6.

Mesotanais longisetosus is immediately distinguished from *M. vadicola* by having a long terminal seta on antenna 1 and peraeonites 2–4 distinctly more elongate. Other characters distinguishing the two species include: (1) the third segment of antenna 1 is more elongate in *M. longisetosus*; (2) the second segment of antenna 2 on *M. longisetosus* bears two stout distal setae (Figure 7) while in the same location on *M. vadicola* there is a single spine with a setae at its base (Figure 1); (3) the distinctly different shape and dentition of the lacinia mobilis (Figures 2 & 8); (4) the pars molaris of *M. longisetosus* is well developed and typical of other leptocheliids while it is reduced in *M. vadicola* (Figures 2 & 8); (5) the outer seta on the maxillipedal endite is much larger in *M. longisetosus* (Figures 2 & 8); and (6) the presence of a ciliated distal spine on the propodus of peraeopods 4 to 6 (Figures 9) in *M. longisetosus*. Both species also differ markedly in the shape of the chelipedal carpus. The following key may be used to further distinguish the two northwestern Atlantic species of *Mesotanais*.

KEY TO THE WESTERN ATLANTIC SPECIES OF *MESOTANAI*S

1. A.1 7-segmented males
- A.1 3- or 4-segmented 2
2. A.1 elongate, 3-segmented, with long terminal setae; pereonites 3 and 4 longer than broad; cheliped with carpus elongate, nearly 3-times longer than broad; pars molaris of mandibles broad; propodus of pereopods 4 to 6 distally with one ciliated spine-like seta *Mesotanaïs longisetosus* n. sp.
- A.1 somewhat less elongate, "pseudo"-4-segmented, terminal setae inserting on a socle which might be interpreted as an additional joint; pereonites 3 and 4 as long as broad; chelipedal carpus about twice as long as broad; pars molaris of mandibles narrowed terminally, crushing area reduced; propodus of pereopods 4 to 6 distally without ciliated spine-like seta *Mesotanaïs vadicola* n. sp.

DISCUSSION

In contrast to *M. vadicola* (Figure 11), *Mesotanaïs longisetosus* is presently known only from the Gulf of Mexico (Figure 6). It was collected in depths ranging from 545 to 1386 m and, therefore, based on the available data, it appears to be a typical inhabitant of the mid-region of the continental slope. The data indicate that with increasing depth the shallower water species, *M. vadicola*, is replaced by *M. longisetosus*. In areas where the slope has a gentle gradient, as in the eastern transect, there is a relatively broad zone where both species are sympatric (Figure 6). Quite often both species were collected at the same station and occasionally occurred in the same replicate sample (Figure 6). To understand the factors limiting the distribution of the two species, more detailed ecological information, e.g. sediment analysis, etc. is needed. The strikingly different development of the pars molaris in each species indirectly indicates a difference in diet.

The differences between *M. longisetosus* and *M. vadicola* and their respective eastern Atlantic cognates (Sieg and Bird, in press) are very pronounced compared with those among species in other genera within the family Leptocheliidae. The discovery of additional taxa or the male stages of *M. longisetosus* and the other two species of the genus from eastern Atlantic may indicate that *M. vadicola* and its eastern Atlantic cognate belong to a distinct subgenus or genus.

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TANAIDACEA (CRUSTACEA: PERACARIDA) OF THE GULF OF MEXICO. VII. *ATLANTAPSEUDES LINDAE*, N. SP. (APSEUDIDAE) FROM THE CONTINENTAL SLOPE OF THE NORTHERN GULF OF MEXICO.

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ABSTRACT During 1983 through 1985, 53 specimens of *Atlantapseudes lindae*, new species, were collected in box core samples taken on the continental slope in the northern Gulf of Mexico. *Atlantapseudes lindae* can be distinguished from the only other member of the genus, *A. nigrichela* Băcescu, 1978 by several characters, including the length of the squama of antenna 2, which is no longer than the third peduncular segment, and the absence of anterolateral spines on pereonites 1-2 of females and 1-6 on males. The diagnosis for genus *Atlantapseudes* Băcescu, 1978 is amended to include the presence of sexually dimorphic chelae and first antennae in fully developed males.

INTRODUCTION

Băcescu (1978) created the monotypic genus *Atlantapseudes* to receive *Atlantapseudes nigrichela* Băcescu, 1978, described from the northeastern Atlantic off the coast of Portugal in depths ranging from 750 to 1250 m. He pointed out that in many respects his material superficially resembled *Apseudes grossimanus* Norman and Stebbing, 1886, which also has been reported from Portuguese waters at similar depths.

This report describes a new species of *Atlantapseudes* from box core samples collected as part of an extensive study of the continental slope in the northern Gulf of Mexico during 1983 through 1985.

Băcescu (1978) characterized the genus *Atlantapseudes* as lacking sexually dimorphic chelae and first antennae. However, fully developed males of the new species are distinctly sexually dimorphic in these structures. This leads us to amend Băcescu's generic diagnosis as follows: Apseudids lacking exopods on chelae and first pereopods; ocular lobes lacking visual elements; pleopods absent in females, five biramous pairs present in males; sexually dimorphic chelae and first antennae present in fully developed males.

Type material has been deposited in the collections of the National Museum of Natural History (USNM) and the Gulf Coast Research Laboratory Museum (GCRL).

We follow Sieg and Heard (1985) in not considering the chela as a pereopod. Pereopods 1-6 are attached to

pereonites 1-6, respectively.

Atlantapseudes lindae, new species

Figures 1-5

Synonymy: Apseudidae A: Gallaway, Martin, and Howard (1988).

Type material examined

Holotype - 1 male, 27°42'46"N, 091°32'58"W, 10 June 1985, 556 m, USNM 221832.

Paratypes - 1 ovigerous female, 27°50'30"N, 090°44'07"W, 12 June 1985, 545m, USNM 221833; 1 ovigerous female, 27°43'31"N, 092°07'57"W, 9 June 1985, 549 m, GCRL 1134.

Additional material

One female, 3 subadult males, 2 juveniles, 27°54'24"N, 090°06'00"W, 26 Nov. 1983, 603 m; 1 male, 1 transitional manca (i.e. those juveniles with the 6th pair of pereopods present but not fully developed), 27°54'18"N, 090°05'54"W, 26 Nov. 1983, 615 m; 1 subadult male, 28°16'48"N, 086°14'53"W, 18 May 1985, 624 m; 1 subadult male, 1 juvenile, 28°02'11"N, 85°40'59"W, 15 May 1985, 624 m; 1 subadult female, 28°15'45"N, 086°37'08"W, 20 May 1985, 852 m; 1 female, 27°35'56"N, 092°21'33"W, 8 June 1985, 750 m; 1 subadult female, 1 transitional manca, 27°50'29"N, 090°44'06"W, 13 June 1985, 547 m;

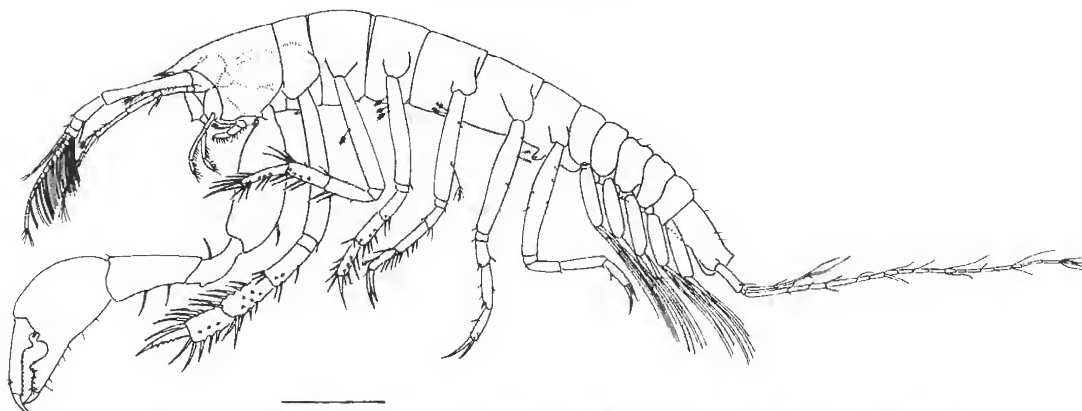


Figure 1. *Atlantapseudes lindae* n. sp.: lateral view of adult male. Scale equals 1.0 mm.

1 subadult male, 1 juvenile, 28°35'26"N, 086°44'27"W, 13 May 1985, 624 m; 1 manca, 1 transitional manca, 27°43'31"N, 092°07'57"W, 9 June 1985, 549 m; 1 subadult male, 1 subadult female, 2 transitional mancass, 27°43'28"N, 092°08'08"W, 9 June 1985, 545 m; 1 female, 1 subadult female, 1 subadult male, 2 mancass, 27°45'37"N, 091°13'07"W, 11 June 1985, 455 m; 2 mancass, 1 transitional manca, 27°50'30"N, 090°44'07"W, 12 June 1985, 545 m; 1 female, 2 subadult females, 1 transitional manca, 27°45'49"N, 091°13'08"W, 11 June 1985, 444 m; 1 subadult male, 1 manca, 1 transitional manca, 27°42'37"N, 091°33'04"W, 4 June 1985, 554 m; 1 female, 1 subadult female, 2 subadult males, 27°45'39"N, 091°13'11"W, 12 June 1985, 454 m; 1 female, 1 subadult male, 1 manca, 27°43'32"N, 092°07'57"W, 9 June 1985, 547 m; 1 subadult male, 28°16'47"N, 086°14'46"W, 18 May 1985, 622m; 1 subadult male, 3 juveniles, 27°50'23"N, 090°44'01"W, 12 June 1985, 550 m.

Diagnosis

Second antenna, squama not longer than third segment. Maxilliped with 3 coupling hooks. Pereonites 1-2 lacking anterolateral spiniform processes in both sexes; 3-6 with weakly developed, acute anterolateral processes in female, lacking in male. Chela, basis with proximal anterior spur; carpus with 2 long, simple setae on posterior surface. Pleonites, lateral margins rounded; acute midventral spinose processes lacking.

Description of male

Body (Fig. 1; 2a) – Length 6.5 mm, about 5.6 times longer than wide.

Cephalothorax (Fig. 1; 2a) – Length-width ratio (including rostrum), 1:1; lateral margin bearing pronounced spine; rostrum well developed, terminally acute.

Pereonites (Fig. 1; 2a) – All wider than long; 1-2 with rounded lateral margins; 3-6 bearing rounded anterolateral processes. Pereonite 1 with anteriorly directed midventral process, processes on remaining pereonites usually smaller.

Pleonites (Fig. 1; 2a, c) – Pleonites 1-4 with rounded lateral margins; pleonite 5 more subquadrate. Keel-like ventral processes present; lateral margins visible dorsally on 1-4.

Pleotelson (Fig. 1; 2a, c) – Length-width ratio 1.6:1; widest at level of uropod attachment.

First Antenna (Fig. 3d) – Peduncle 4-segmented; first peduncular segment approximately 3 times longer than second, bearing 3 broom setae proximally, 2 broom setae and 1 simple seta at midlength on outer margin; second peduncular segment with one long seta distally on outer margin, inner margin with 1 short seta proximally, 2 setae distally; third peduncular segment bearing 1 seta distally on inner margin; fourth peduncular segment with projection at junction with inner flagellum. Inner flagellum with 5 segments; outer flagellum with 16 segments, proximally bearing rows of long aesthetascs along medial margins, becoming less numerous distally, last segment reduced. Last segment of both inner and outer flagella bearing 4 terminal setae.

Second Antenna (Fig. 3b) – Composed of 12 segments; second segment with 1 proximal seta on outer margin, small squama distally on inner margin, squama shorter than third segment, bearing 2 terminal setae of different lengths; third segment with 1 seta distally on outer margin; fourth segment with 1 seta distally on outer margin followed by 2 broom setae; fifth segment, inner margin with 1 short seta at midlength, followed by 1 broom seta more distally, outer margin with 1 long seta at midlength, 3 smooth setae and 1 long broom seta more distally; sixth segment, inner margin with 1 long seta at midlength and 1 shorter seta distally; segments 7-11 each bearing 1-2 setae distally; last segment with 4 terminal setae and 1 aesthetasc.

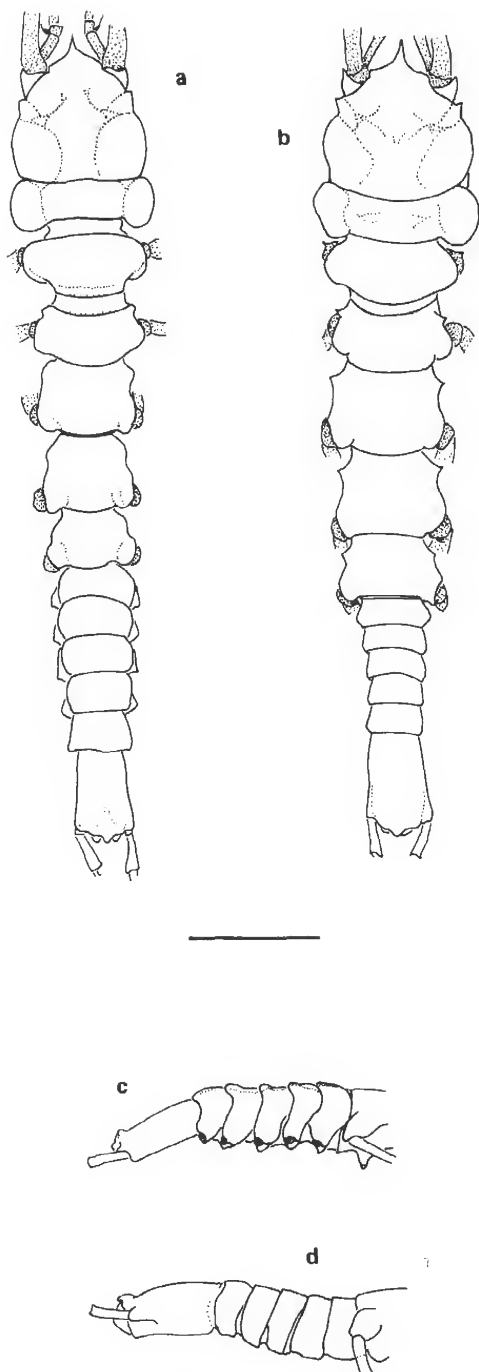


Figure 2. *Atlantapseudes lindae* n. sp.: (a) adult male, dorsal view; (b) ovigerous female, dorsal view; (c) adult male pleon, lateral view; (d) ovigerous female pleon, lateral view. Scale equals 1.0 mm.

Clypeolabral complex (Fig. 4b) – Clypeus bearing well-developed spine-tooth with tip curved ventrally. Labrum subdivided in two parts by labral suture, posterior half bilobed, surface covered with fine setae.

Mandibles (Fig. 3g, h) – Pars molaris and pars incisiva with irregular cutting edge. Left mandible with 5-dentate lacinia mobilis; spiniferous lobe with 8 spined teeth. Right mandible with lacinia mobilis reduced to one strong forked spine; spiniferous lobe with 5 spined teeth. Palp three-segmented, first segment bearing one seta at midlength on inner margin; second segment about 4 times longer than first, with 12–13 distally pinnate setae; third segment bearing 14–15 distally pinnate setae on inner and medial margins.

Labium (Fig. 4d) – Large terminal palp covered with fine setules, bearing three spine-like setae distally.

Maxilla 1 (Fig. 4a) – Outer endite with 11 terminal spines and 2 subterminal, stout, plumose setae; inner endite bearing 1 finely setulose seta, 1 completely plumose seta, and 1 partially plumose seta; palp 2-segmented, with 1 long, simple terminal seta and 2 shorter subterminal setae with spoon-shaped tips armed distally with fine, recurved setules (Fig. 4a enlargement).

Maxilla 2 (Fig. 4f) – Fixed endite, medial setal row with 16 finely plumose setae and 2 distally serrate setae; terminal armament composed of three tridentate spines and 8 setae, 6 of which are partially or completely pinnate. Movable endite, inner lobe with 4 distally pinnate setae and 1 plumose seta; outer lobe with 2 subterminal and 5 terminal, distally pinnate setae (2 bearing several long, proximal setules), outer margin with two protuberances bearing small spinules.

Maxilliped (Fig. 4c, e) – Palp 4-segmented; first segment with 1 stout, simple lateral seta; second segment with 1 long distolateral seta and 13 setae along inner margin; third segment with 8–9 setae along inner margin; fourth segment with 11 setae scattered on distal third of article. Setae of segments 2–4 finely pinnate distally under high magnification. Endite subtriangular (Fig. 4c), bearing 6 stout, plumose marginal setae and 3 submarginal coupling hooks medially; distal margin with 7 spines (2 finely plumose, 1 finely plumose with ring of setules in proximal third, 1 setulose, 3 with strong distal groove and ring of setules near base).

Epignath (Fig. 4g) – Margin edged with short setules; terminal spine with scattered short setules; frontal lobe fringed with longer setules; 2 proximal accessory plates with scattered clumps of setae on surface.

Cheliped (Fig. 5b) – Exopod absent; coxa reduced, obscured from view by lateral margins of cephalothorax; basis over twice as long as broad, antero-proximal spur present, spine-seta in posterodistal third; fused ischium-merus with distal tooth on posterior surface, 1 long anterior seta; carpus with short setae scattered on surface, 2 long, simple setae posteriorly;

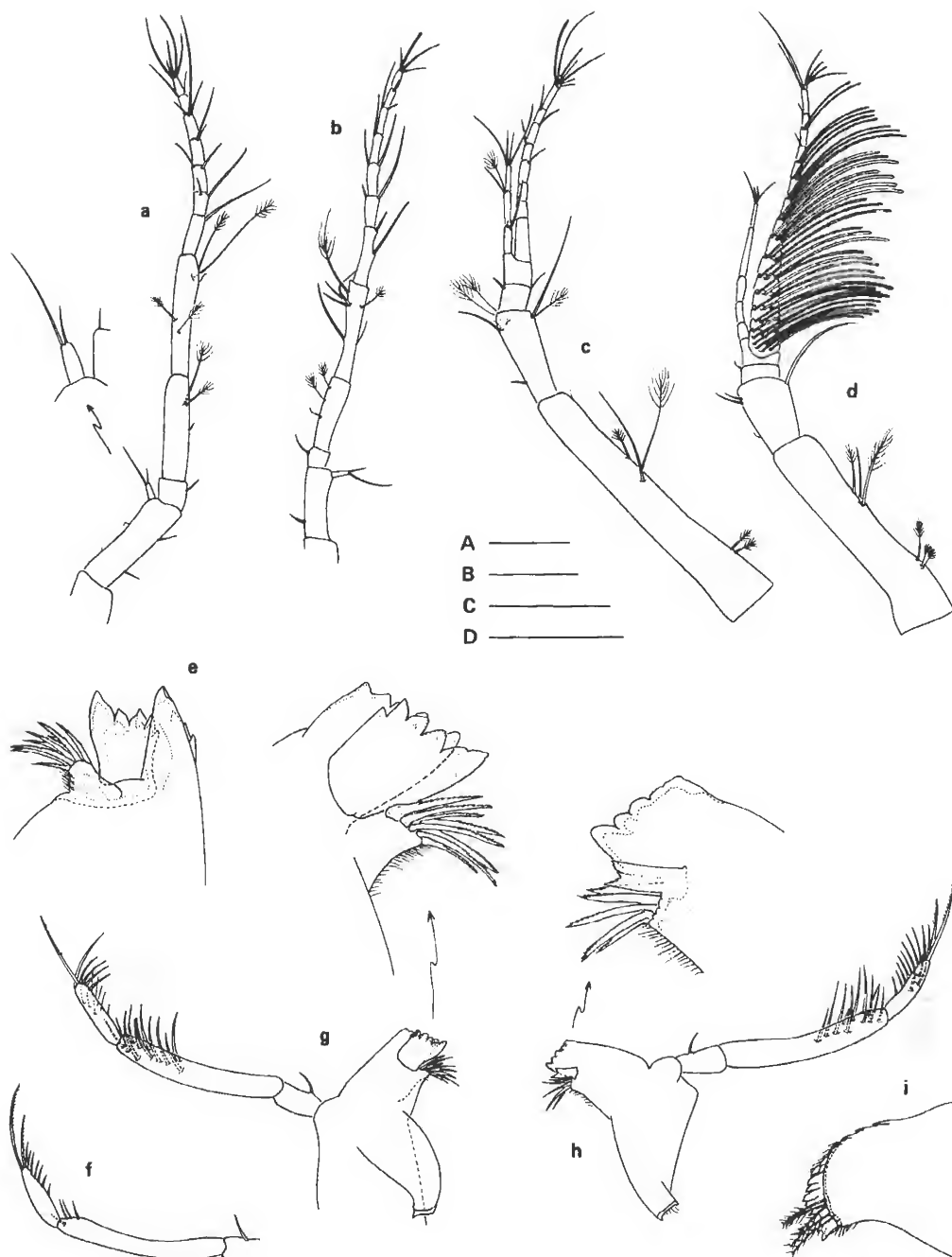


Figure 3. *Atlantapseudes lindae* n. sp.: (a) second antenna, adult female, with enlargement of squama, ventral view; (b) second antenna, adult male, dorsal view; (c) first antenna, adult female, ventral view; (d) first antenna, adult male, ventral view; (e) right mandible, adult female; (f) mandibular palp, adult female; (g) right mandible, adult male; (h) left mandible, adult male; (i) molar process, adult female. Scale A for (e) equals 0.1 mm; scale B for (f-h) equals 0.2 mm; scale C for (a-d) equals 0.5 mm; scale D for (i) equals 0.1 mm.

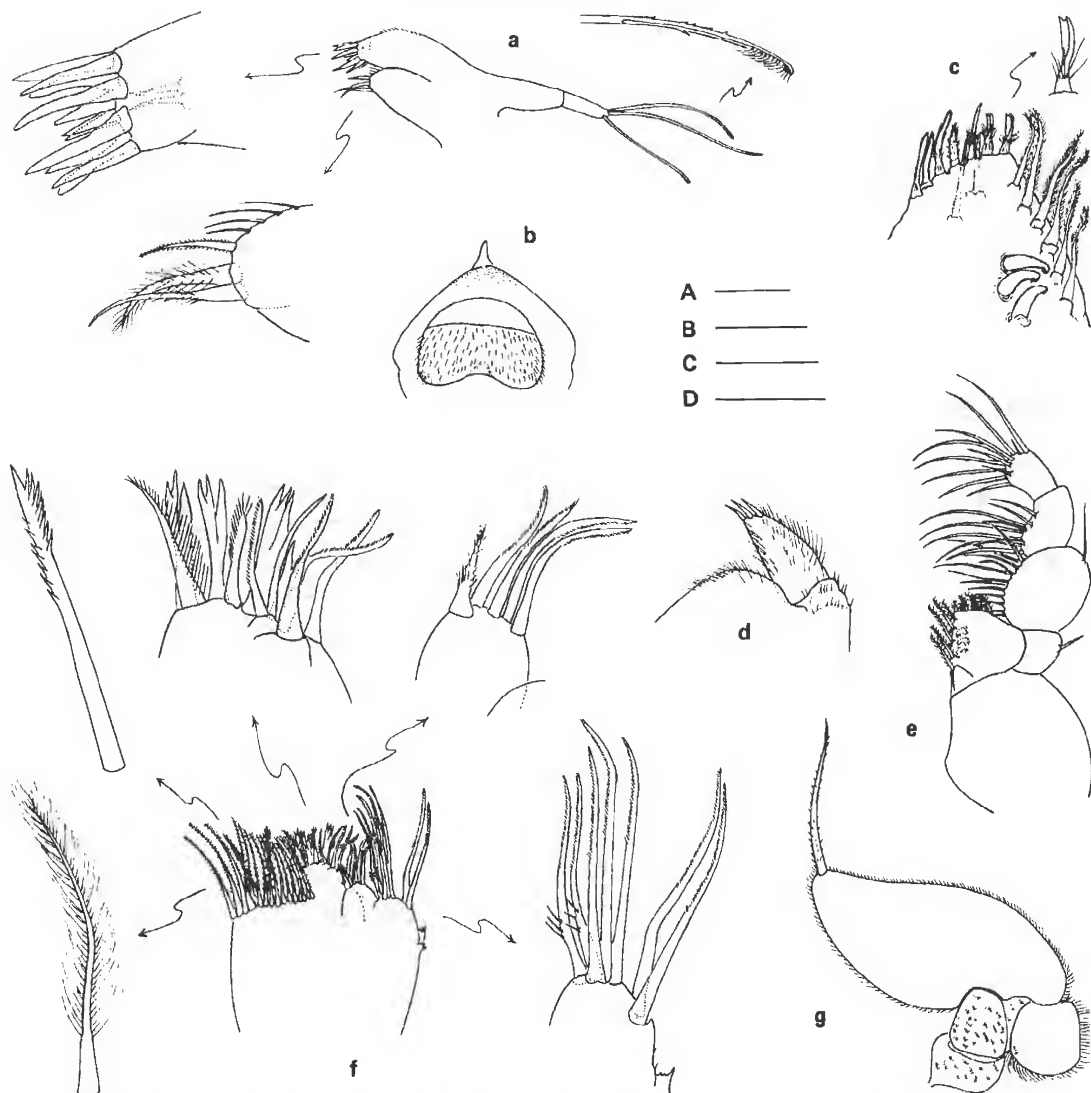


Figure 4. *Atlantapseudes lindae* n. sp.: Male (a) first maxilla; (b) clypeolabral complex; (c) enlargement of endite of maxilliped; (d) labium; (e) maxilliped; (f) second maxilla; (g) epignath. Scale A for (b, g) equals 0.2 mm; scale B for (d, f) equals 0.1 mm; scale C for (a, e) equals 0.2 mm; scale D for (c) equals 0.1 mm.

propodus and fixed finger combined about 1.5 times longer than ischium-merus, posterior edge with scattered setae; fixed finger with 2 blunt teeth separated by deep, broad notch, cutting edge bearing about 22 deep-rooted, sharp-edged teeth of various shapes and sizes, interspersed with setae (Fig. 5b enlargement); gape with 2 setae between proximal tooth and dactylar articulation; dactylus longer than fixed finger, bearing 1 proximal tooth followed by about 12 articulated distal spine-teeth. Tips of propodus and dactylus

smooth.

Pereopod I (Fig. 5e, f, g) – Fossorial; basis longer than ischium, merus, and carpus combined, with one distal seta on posteromedial margin; ischium reduced; merus with 1 proximal and 2 distal setae on posterior margin, anterodistal margin with group of 4 setae; carpus with posterior margin bearing 5 spine-setae, each armed with minute spinules, anterior margin with 6 setae, with only the distal-most seta bearing spinules (Fig. 5e); propodus slightly longer than carpus, pos-

terior margin with 5 spine-setae, all with spinules, anterior margin with 4 spine-setae, 2 with spinules. Short spine-like setules scattered on surface of merus, carpus, and propodus. Dactylus narrow with 5 serrate teeth on posterior margin and sharp styliform tip (Fig. 5g).

Pereopod II (Fig. 5i) – Nonfossorial; basis subequal to combined length of merus, carpus, and propodus, with short setae scattered posteriorly and 1 broom seta at midlength anteromedially; ischium bearing 1 posterior seta; merus with 2 proximal and 2 distal setae on posterior margin, anterior margin with 1 seta at midlength and 2 distally; carpus almost as long as merus, with 1 seta at midlength, 3 long distal setae on anterior margin, and 4 long setae on distal half of posterior margin, with accompanying medial row of 4 shorter setae; propodus longer than carpus, with distal posterior margin bearing 4 long setae, anterior margin bearing 6 setae, with medial row of 6 shorter setae; dactylus almost as long as propodus, bearing few short setules.

Pereopod III (Fig. 5j) – Similar to pereopod II. Basis with 3 broom setae proximally on anterior margin, several fine setae on surface, 1 posterodistal seta; ischium with 1 posterodistal seta; merus with 1 distal seta anteromedially, 2 long posterodistal setae, 1 short seta medially; carpus about same length as merus, 2 distal setae anteriorly, 4 setae along posterior margin, with row of 3 setae medially; propodus longer than carpus with 4 long anterodistal setae, 4 setae posteriorly with medial row of 5 shorter setae; dactylus slightly longer than propodus with scattered fine setules.

Pereopod IV (Fig. 5k) – Basis bearing 2 broom setae proximally on anterior margin, 1 long broom seta at midlength near posterior margin, and additional small scattered setae; ischium with 1 fine seta posteriorly; merus with 1 distal seta on anterior margin, 2 distal setae on posterior margin; carpus distinctly longer than merus, with 7 setae along posterior margin, 3 long setae on distolateral margin; propodus with 1 broom seta on proximal third of anterior margin, 1 seta on same area posteriorly, distal end with 1 pinnate seta (see Fig. 5k enlargement) and 1 strong seta longer than dactylus; dactylus shorter than propodus.

Pereopod V (Fig. 5l) – Posterior-anterior orientation often reversed when attached to specimen (see Fig. 1). Basis with 2 broom setae on proximal third anteriorly, shorter setae scattered on surface; ischium with 1 fine seta posteriorly; merus with 1 long seta distally on anterior and posterior margins; carpus bearing 5 setae on posterior margin and 1 fine seta on anterior margin; propodus with one seta at midlength posteriorly, 1 short seta more proximally, 1 3-pointed seta near anterior margin (see Fig. 5l enlargement), 1 long, stout, distal seta adjacent to dactylus; dactylus slightly longer than propodus.

Pereopod VI (Fig. 5m) – Similar to pereopod V

(illustrated with orientation reversed). Basis with scattered short setae on surface; ischium with 1 fine seta on posterior margin; merus with 1 distal seta on posterior margin; carpus with distal spine on posterior margin, few scattered setae on surface; propodus with 1 seta at midlength on posterior margin and 3 distal setae adjacent to dactylus; dactylus slightly longer than propodus, with a few short setules.

Pleopods (Fig. 5c) – Protopod long, almost twice as long as endopod, 1 plumose seta distally; endopod and exopod bearing many (30–40) long plumose setae.

Uropod (Fig. 5a) – Basis with one distomedial seta; exopod 5-segmented, second segment with 2 distal setae, last segment with 4 long terminal setae; endopod with 10–20 segments due to large number of fused or pseudo-segments, bearing irregularly scattered setae distally on segments, last segment with 5 long terminal setae.

Description of female

Similar to male except for the following:

Body, Cephalothorax, Pereonites (Fig. 2b) – Length 7.0 mm, about 4.6 times longer than wide. Cephalothorax and pereonites similar to male except anterolateral processes on pereonite 3–6 more acute; mid-ventral process on pereonite 1 reduced and blunt on ovigerous females.

Pleonites (Fig. 2b, d) – As in male, but ventral keels lacking.

First Antenna (Fig. 3c) – Peduncle 4-segmented; first segment with 2 short broom setae proximally, 1 long broom seta, 1 short broom seta, and 1 long simple seta at midlength on outer margin, scattered short setae on surface; second segment with 2 broom, 1 simple seta distally on inner margin, 1 broom, 1 very long seta on outer margin distomedially; third segment with 1 seta distally on each side. Inner flagellum 3-segmented; first segment with 1 short, 1 long seta distally; second with 1 simple seta and 1 broom seta distally; last segment with 4 terminal setae. Outer flagellum of 9–11 segments; segments 4–7 with 1–2 distal setae; penultimate segment with 1 short seta, 1 long seta, and 1 aesthetasc; terminal segment reduced, with 4 setae.

Second Antenna (Fig. 3a) – Composed of 12 segments; first 4 segments same as male; fifth segment with 2 broom setae at midlength medially, 2 longer broom setae distally on outer margin; segments 6–11 with 1–3 setae distally; last segment with 5 terminal setae.

Mandibles (Fig. 3e, f, i) – As in male, except second segment of palp bears only 4 setae, third segment with 9 setae.

Maxilla 2 – Similar to male, except medial setal row with 17 finely plumose setae and 2 distally serrate setae; movable endite, inner lobe with 6 distally pinnate setae and 1 plumose seta, outer lobe with 3

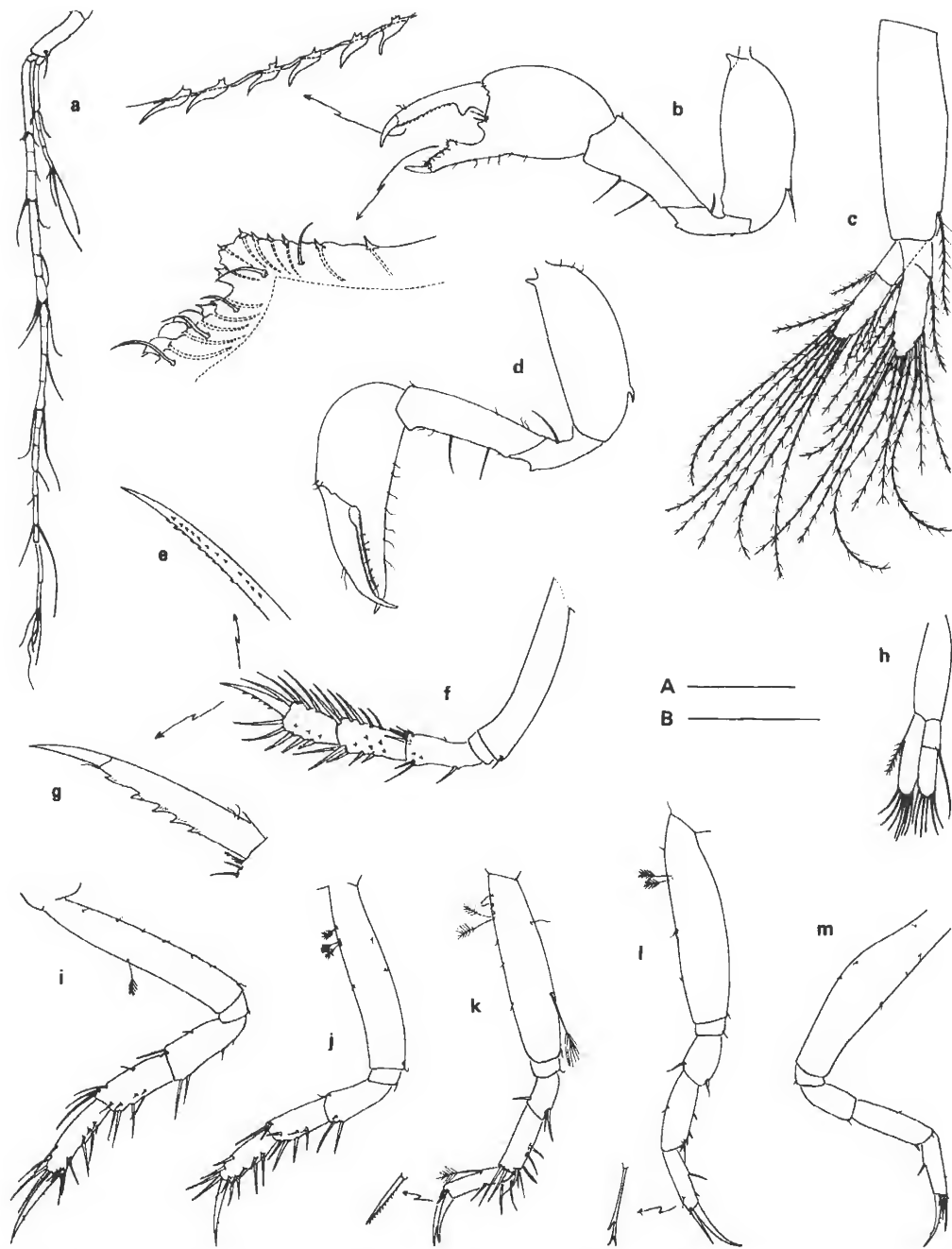


Figure 5. *Atlantapseudes lindae* n. sp.: All male except (d); (a) right uropod; (b) left chela, enlargement of propodus and dactylus; (c) pleopod, adult male; (d) left chela, female; (e) enlargement of spinose spine-seta of pereopod I; (f) left pereopod I; (g) enlargement of dactylus of pereopod I; (h) pleopod, subadult male; (i) left pereopod II; (j) left pereopod III; (k) left pereopod IV; (l) left pereopod V; (m) left pereopod VI. Scale A for (a, i-m) equals 0.6 mm; scale B for (b, d, f) equals 1.0 mm; scale B for (c, h) equals 0.4 mm.

TABLE 1

Characters separating *Atlantapseudes nigrichela* and *A. lindae*.

Character	<i>A. nigrichela</i>	<i>A. lindae</i>
Sexual dimorphism:		
Chela	Not observed*	Present
1st antenna	Not observed*	Present
Pleopods	Present in male	Present in male
Antenna 1:		
Inner flagellum	3 segments in both males and females*	3 segments in female, 5 in fully developed male
Outer flagellum	7 segments, 1 aesthetasc distally on both sexes*	9–11 segments in female, 16 on fully developed male, female with 1 aesthetasc on penultimate segment, male with 100+ aesthetascs
Antenna 2	10 segments; squama, excluding terminal setae, about 3 times as long as 3rd peduncular segment.	12 segments in both sexes; squama, excluding terminal setae, about equal in length to 3rd peduncular segment.
Maxilla 1: palp	2 setae	3 setae
Number of coupling hooks on maxilliped	4 coupling hooks	3 coupling hooks
Setal type on carpus (posterior margin)	2 plumose setae	2 simple setae
Pereonites: antero-lateral margins	Well developed, anterolateral spiniform processes on 1–6 of both sexes	Female: 1–2 unarmed, rounded, 3–6 with weakly developed, anterolateral acute processes; male: 1–6 unarmed, rounded
Pleonites	1–5 armed with posteriorly directed, ventrolateral, spiniform processes	1–5 lacking ventrolateral spiniform processes

* It is probable that Băcescu did not have a fully developed male in his type series.

of the terminal pinnate setae bearing long proximal setules.

Cheliped (Fig. 5d) – Basis with small, curved spine-tooth on posterior margin, replacing long spine-seta of male; fixed finger and dactylus lacking teeth, cutting edge of dactylus with shallow notch proximally at articulation with propodus, cutting edges of both dactylus and fixed finger armed with spine-teeth, tips smooth.

Subadult males and females

Subadult males and females are similar to adult females except that they lack oostegites. Subadult males, like adult males, have a genital cone, although smaller in size, on the sixth thoracic somite. Subadult females also lack pleopods.

Pleopod of subadult male (Fig. 5h) – Pleopod simi-

lar to that of adult male except much smaller in size. Protopod lacking setae; exopod bearing one long smooth seta on distal end of first segment; endopod with only one plumose seta at midlength. Setae on terminal ends of exopod and endopod simple, fewer in number, and much shorter than in adult male.

Etymology

Named in honor of Dr. Linda H. Pequegnat in recognition of her many contributions to marine zoology.

Remarks

Atlantapseudes lindae can be readily distinguished from *A. nigrichela* by the length of the squama of antenna 2, which is no longer than the third pedun-

cular segment, and by the absence of anterolateral spines on pereonites 1-2 of females and 1-6 of males. These and other characters separating the two species are listed in Table 1.

An important characteristic of *A. lindae* is the presence of sexual dimorphism. Fully developed males possess distinct chelae, first antennae, and more fully developed pleopods than previously described for the genus. Subadult males have antennae and chelae that resemble the females, thus resembling the type males described for the type species, *A. nigrichela*. Since the pleopods of subadult male *A. lindae* are similar in relative size and structure to those described for the males of *A. nigrichela*, we suggest that Băcescu (1978) did not have fully developed males in his type collection.

ACKNOWLEDGMENTS

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TANAIDACEA (CRUSTACEA: PERACARIDA) OF THE GULF OF MEXICO. VIII. *PSEUDOSPHYRAPUS SIEGI*, N. SP. (SPHYRAPIDAE) FROM THE CONTINENTAL SLOPE OF THE NORTHERN GULF OF MEXICO

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ABSTRACT *Pseudosphyrapus siegi*, n. sp. is described from benthic samples collected in deep water (595-2400 m) from the northern Gulf of Mexico. Of the five currently recognized species of *Pseudosphyrapus* Guju, 1980, *P. siegi* is most closely related to *P. dispar* (Lang, 1968), a southwestern Pacific cognate and only other member of the genus having a squama on antenna 2. *Pseudosphyrapus siegi* is distinguished from *P. dispar* by: (1) a more triangular, but less acute, rostrum (2) the presence of two 4-pronged spines on the second maxilla (homologous spines on *P. dispar* are 3-pronged), and (3) the absence of a spiniform process on the chelipedal carpus. Other less noticeable differences between the two species occur in the setation or spination of the maxilliped and pereopods. Except for a small genital cone on males and developing oostegites on females, no noticeable sexual dimorphism (e.g., setation of antenna 1, enlargement or modification of chela and pereopod 1 in males) was exhibited by the specimens of *P. siegi* examined. It is probable, however, that more fully developed and sexually dimorphic males exist for *P. siegi*. The limited collection data suggests that body size in *P. siegi* may increase with depth. A key to the species of the genus *Pseudosphyrapus* is included.

INTRODUCTION

Guju (1980) created the family Sphyrapidae to receive the type genus *Sphyrapus* Norman and Stebbing, 1886 and the new genus *Pseudosphyrapus*. He distinguished *Pseudosphyrapus* from *Sphyrapus* by the presence of a mandibular palp in the former and its absence in the latter. To his new genus he assigned three species, *P. serratus* (G.O. Sars, 1882), *P. anomalus* (G.O. Sars, 1869), and *P. dispar* (Lang, 1968), all formerly placed in the genus *Sphyrapus*. Two additional species of *Pseudosphyrapus*, *P. centobi* Băcescu, 1981 and *P. gutui* Kudinova-Pasternak, 1985, have since been described. Of the five nominal species within *Pseudosphyrapus*, three, *P. anomalus*, *P. centobi*, and *P. serratus*, are known from the north Atlantic, and two, *P. dispar* and *P. gutui*, are known from the southern Pacific and southwestern Indian Oceans, respectively (see Guju 1980, Băcescu 1981, Kudinova-Pasternak 1985).

During studies on the deep water fauna of the northern Gulf of Mexico conducted by Texas A&M University in 1966 and LGL Ecological Associates, Inc. during 1984-1986, specimens of a sixth species of *Pseudosphyrapus* were collected. The description of this new species is presented here.

In this report females with developing, but not fully formed, oostegites are referred to as preincubatory

females. The term transitional manca refers to those juveniles with the sixth pair of pereopods present, but not fully developed. Other descriptive terminology used in this report generally follows that of Sieg and Heard (1989). The following abbreviations are used in the text: BT (bottom temperature), BC (25 cm x 19.5 cm box corer), MWT (mid-water trawl), USNM (U.S. National Museum), GCRL (Gulf Coast Research Laboratory), and P 1-6 (pereopods 1-6).

Pseudosphyrapus siegi, new species

Figures 1-5

Synonymy: *Sphyrapus* sp. 1: Gallaway, Martin, and Howard (1988)

Type Material

Holotype - Subadult (?) male (body length 6.0 mm, cephalothorax length 1.5 mm), USNM 221853, 28°04.3'N, 086°34.8'W, 1410 m, BT 4.3°C, LGL Sta. E-4 (2417), Cruise 2, BC, April 17, 1984.

Paratypes - One subadult female (4.0 mm), USNM 221854, 26°57.6'N, 089°35.1'W, 2400 m, BT 4.2°C, C-5 (2337), Cruise 2, BC, April 14, 1984; 1 subadult female (6.1 mm), GCRL-1134, 1 subadult (?) male

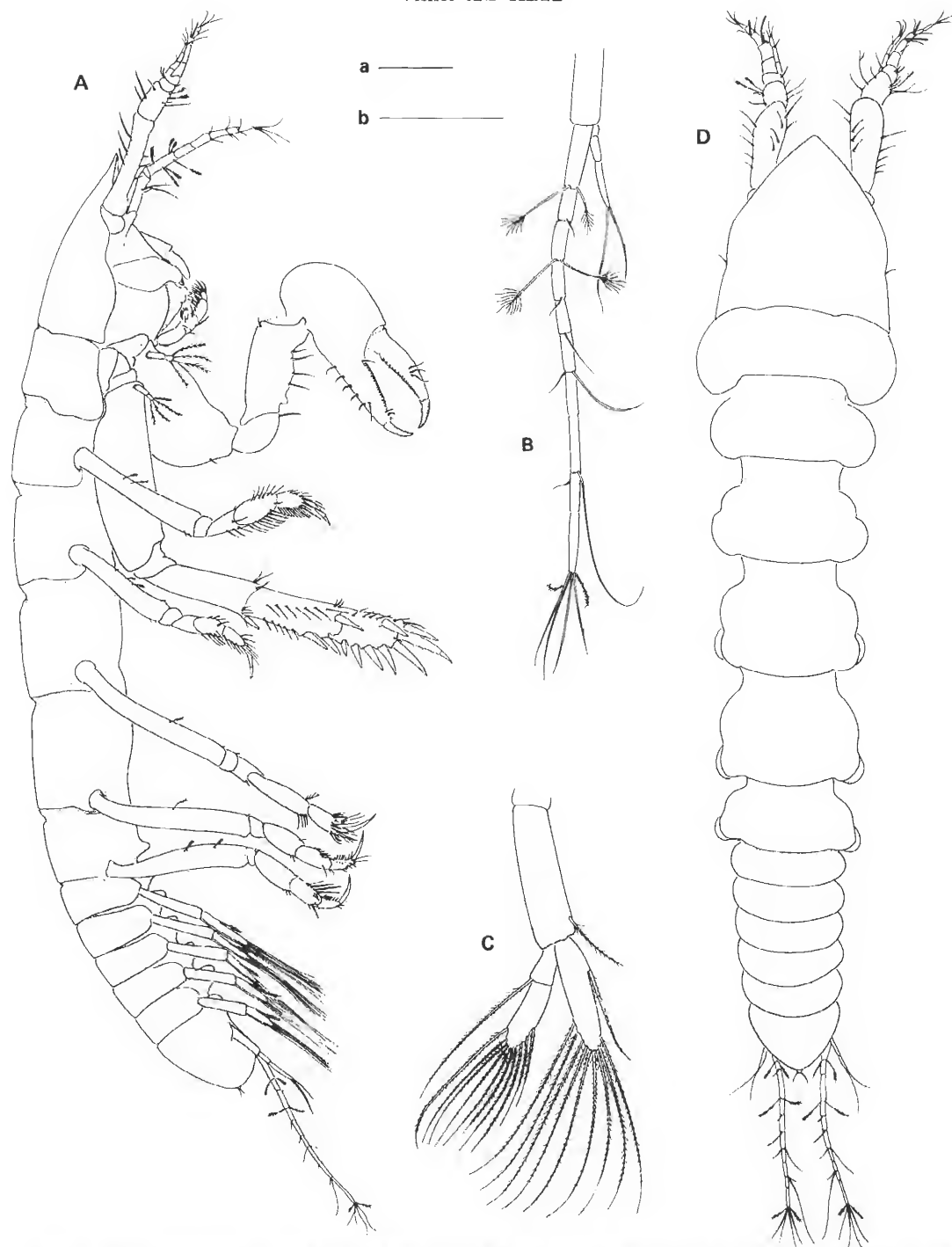


Figure 1. *Pseudosphyrapus siegi* n. sp. (A) subadult(?) male holotype, lateral view; (B) uropod, preincubatory female (6.0 mm); (C) pleopod 1, preincubatory female; (D) holotype, dorsal view. Scale a = 0.2 mm for B, C; Scale b = 1.0 mm for A, D.

(6.1 mm), coll. of J. Sieg, 28°20'N, 087°03'W, 1097–1189 m, R/V Alaminos, Sta. 66-A5-4, MWT (hit bottom), W. Pequegnat, coll., April 6, 1966.

Additional material

One subadult female (5.7 mm, dissected remnants), 1 preincubatory female (6.0 mm, dissected remnants), GCRL-1135, 28°13.5'N, 087°04'W, 1000 m, R/V Alaminos, Sta. 66-A-9-XV, MWT (hit bottom), July 11, 1966, W. Pequegnat, coll.; 1 subadult female (5.2 mm), 1 transitional manca (3.0 mm), 1 manca (2.0 mm), USNM 221856, 27°28.3'N, 089°47'W, 1390–1394 m, BT 4.3°C, LGL Sta. C-4 (2257, 2271, 2278), Cruise 2, BC, April 13, 1984; 1 subadult female (4.0 mm), USNM 221857, 27°29.1'N, 089°47.25'W, 1388 m, BT (unknown), LGL Sta. C-09 (3054), Cruise 3, BC, November 15, 1984; 1 small preincubatory female (3.7 mm with developing oostegites), USNM 221855, 27°54.5'N, 090°6.2'W, 595 m, BT 7.5°C, LGL Sta. C-2 (2183), Cruise 2, BC, April 11, 1984.

Diagnosis

Rostrum triangular, lateral margins straight or slightly convex, fusion with cephalothorax uninterrupted laterally; mandibular palp, segment 2 with 7 distal setae; maxilliped, coxa with 5 short spinules on lateral margin, distal segment of palp with 9–10 setae; maxilla 1, distal segment of palp with 5 to 6 subterminal harpoon-tip setae and 1 terminal hooked seta; maxilla 2, fixed endite with 2 large four-pronged spines, 1 bifurcate spine, 4 finely serrate spines, and 1 simple spine; cheliped with carpus lacking distal spinose process on anterior margin; postero-lateral margins of pleonites rounded in dorsal view.

Description of subadult female

Body (as in Fig. 1A, D) – 4.0–6.1 mm long, about 4.0 times longer than wide.

Cephalothorax (as in Fig. 1A, D) – Approximately as long as broad, anterior third narrowed, tapering to fuse with rostrum; rostrum triangular, fusion with cephalothorax uninterrupted laterally; 1 small pair of mid-lateral setae evident. Eyelobes reduced, rounded, without visual elements.

Pereonites (as in Fig. 1A, D) – Lateral margins appearing gently rounded in dorsal view, margins of each somite with 1 setae ventrally not visible from dorsal view; first pereonite widest, 3 times broader than long; pereonite 5 nearly twice length of pereonite 6.

Pleon (as in Fig. 1A, D) – Less than half length of

pereon; pleonites similar in size, each approximately 2/3 length of last pereonite, each pleonite with postero-lateral margins rounded in dorsal view (Fig. 1D) and with rounded conical ventral process (Fig. 1A).

Antenna 1 (Fig. 2A) – Peduncle 3-segmented, setation as illustrated, first segment strongly developed and nearly as long as the remaining segments and flagella combined, second segment approximately 2/5 length of first, third segment reduced with complex sculpturing and articulation with flagella; smaller dorsomedial flagellum composed of 3 segments, first and second segments with outer distal margin bearing single simple curved seta, third segment terminating 1 broom seta and 3 curved basally inflated simple seta; larger ventral flagellum composed of 4 (?) segments narrowing distally, articulation with last peduncle segment complex having partially articulated scale or reduced segment bearing small broom seta distally, first (distinct) segment lacking setae, second segment with 1 simple seta and 1 aesthetasc distally, third segment with 2 simple setae and 1 aesthetasc distally, fourth segment appearing partially segmented with 1 small simple seta midlength at pseudoarticulation and terminating in 3–4 basally inflated setae.

Antenna 2 (Fig. 2B) – Peduncle, first segment stout (width about 3/4 length), inner face concave with surface rugose; second segment nearly twice length of segment 1, but distinctly narrower with midventral margin bearing minute squama ("sacle" of Lang 1968) having a long terminal seta. Flagellum with 7 segments decreasing in width distally, first segment short, wider than long with single small seta dorsally; second segment elongate, bearing several broom and small simple setae distally and near midlength, length slightly longer than combined lengths of segments 3–7; third segment without setae; fourth, fifth, and sixth segments each with a dorsal and a ventral seta distally, distal broom seta also present on fifth segment; seventh segment with 3 terminal simple setae.

Labrum (Fig. 2D) – Bipartite with clump of setae below division on lower half.

Mandibles – With well developed pars molaris, pars incisiva, and palp (Fig. 3C). Pars molaris (Fig. 3A) having oval grinding surface with outer margin bearing 1 semicircular row of setae and sharp spine-teeth; pars incisiva of right mandible (Fig. 3D) with 4 serrate spine-setae and lacinia mobilis reduced, bilobate (1 lobe acute, other denticulate); pars incisiva of left mandible (Fig. 3E, F) with 4 long, deeply bifurcate, serrate spine-setae, lacinia mobilis well developed with 4 prominent teeth; palp (Fig. 3B) 3-segmented, segment 2 with 7 distal plumose setae, segment 3 with 16–17 plumose setae.

Labium (Fig. 2C) – Covered with setae; palp with 1 terminal, distally bifurcate seta with one of its tips also minutely bifurcate.

Maxilla 1 (Fig. 4A, B) – Outer endite with 11 terminal spines, 2 subterminal spines; inner endite with 4

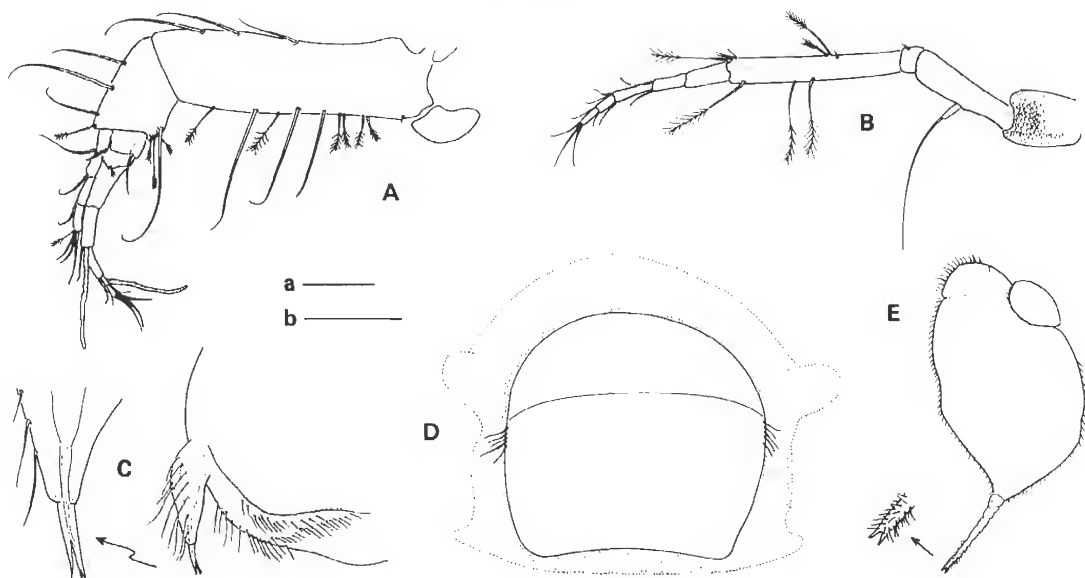


Figure 2. *Pseudosphyrapus siegi* n. sp. Preliminary female (6.0 mm). (A) antenna 1, (B) antenna 2, (C) labium, (D) labrum, (E) epignath. Scale a = 0.1 mm for C, D; 0.2 mm for A, B; Scale b = 0.2 mm for E.

stout, pinnate setae; palp having distal segment armed with 1 long terminal seta with uncinat tip, and 5 to 6 subterminal, shorter, "harpoon-tipped" setae.

Maxilla 2 (Fig. 4E) – Shape typical of genus. Fixed endite with 2 short, subapical, plumose setae; distal margin armed with 2 large 4-pronged spines, 1 bifurcate spine, 4 finely serrate spines, 1 simple spine. Movable endite with inner lobe bearing 8 setae (2 adjacent to fixed endite with broad, finely setose bases); outer lobe with 6 large setae (2 finely setose near base). Medial setal row with approximately 36 setae, appearing distally bifid; 3 serrate spine-setae on disto-medial margin immediately adjacent to setal row.

Maxilliped (Fig. 4C, D) – Coxa well developed with 5 short plumose spinules along lateral margin, basis reduced (not figured); palp 4-segmented, segment 1 nearly as long as broad; endite with 2 couplers, 14 plumose setae, and 4 rectangular, longitudinally grooved, plumose spine-setae.

Epignath (Fig. 2E) – Broad with 2 frontal lobes present, covered with fine setae, terminal spine bifurcate, finely setose distally.

Cheliped (Fig. 5A, B) – Basis with 2 short setae, exopod prominent with 4 terminal plumose setae; merus with 1 anteromedial seta; carpus longer than merus, 4 posterior setae, 1 distal anterior seta; fixed finger of propodus with 5 posterior setae, 4 distal posterior setae, 1 seta at articulation of dactylus; dactylus with clump of 3 setae; teeth on grasping and/or cutting edges of propodus and dactylus as figured (5B).

Pereopod 1 (Fig. 5C) – Coxa as broad as long with 1 small distal seta; basis 4 times longer than coxa, exopod small with 4 terminal plumose setae; ischium very short, 1 distal posterior seta; merus half as long as basis, 1 posterior, subterminal spine, 5 posterior setae, 4 anterior seta; carpus nearly same length as merus, flexor margin with 2–4 spines on distal half and 3 setae on proximal half, extender margin with row of 7–9 setae, and distal spine; propodus with flexor margin bearing 4 to 5 spines (increasing in size distally) and 1 small distal seta, extender margin with distal half bearing 2 spines and 3 setae; dactylus same length as carpus, with 3 minute teeth on flexor margin, 1 minute proximal seta on extender margin.

Pereopod 2 (Fig. 5D) – Basis more slender than P 1 with 2 broom setae on mid-anterior margin; ischium like that of P 1; merus with 1 distomedial seta and 3 setae on distal half of flexor margin; carpus with 10 spiniform setae on flexor margin and 6 spiniform setae on extender margin, 1 small medioproximal seta, 1 mediiodistal seta; propodus with 9 spiniform setae on flexor margin and 5 spiniform setae on extender margin; dactylus styliform with small proximal seta on extender margin and small deeply cleft subapical setule just proximal to small unguis.

Pereopod 3 (Fig. 5E) – Similar proportions and armament as for P 2; except merus having 1 seta on flexor margin; carpus with 5 spiniform setae on extender margin.

Pereopod 4 (Fig. 5F) – Distinctly larger than other pereopods. Basis with 1, posteromedial, plumose seta;

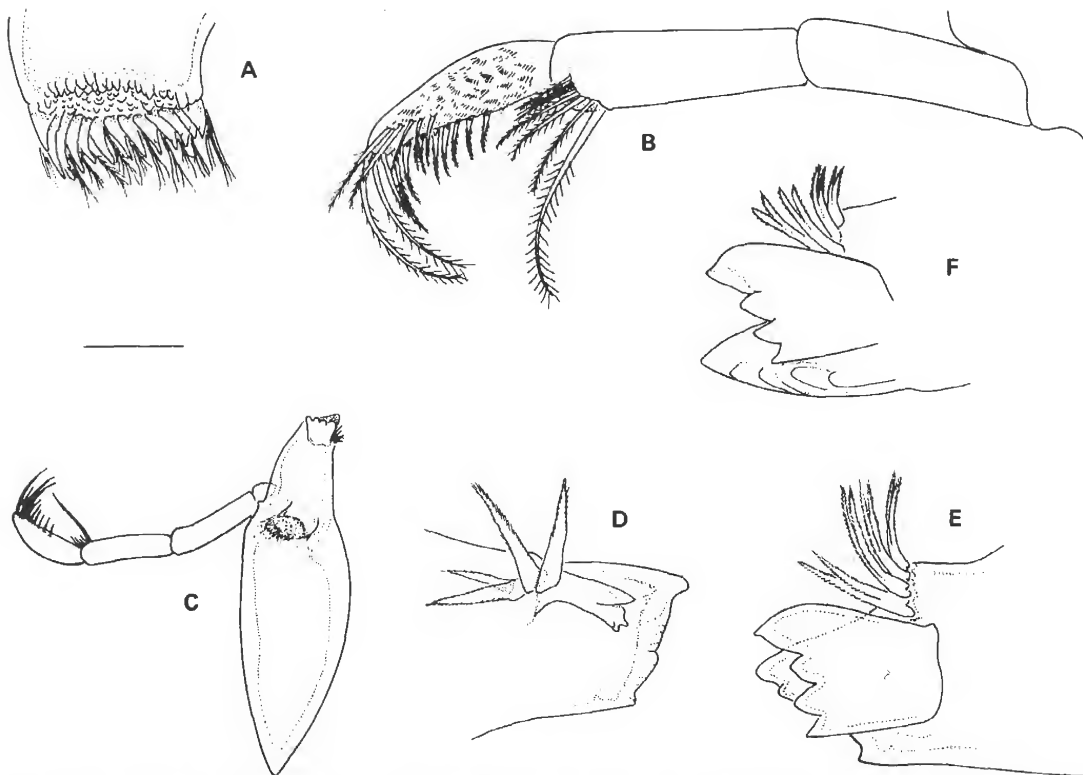


Figure 3. *Pseudosphyrapus siegi* n. sp. Preincubatory female (6.0 mm). (A) pars molaris; (B) palp; (C) left mandible; (D) right mandible, pars incisiva; (E-F) left mandible, two views of pars incisiva and lacinia mobilis. Scale = 0.05 mm for A, D-F; 0.1 mm for B; 0.2 mm for C.

ischium as in P 3; merus with 2 setae distally on posterior margin; carpus about 1.5 length of merus with distal half having 10 spiniform setae; propodus with flexor margin bearing 5 spiniform setae, 2 subterminal rows each with approximately 12 serrate setae; dactylus narrower than P 3, but with similar setation.

Pereopod 5 (Fig. 5G) – Shorter than P 4. Basis equal to combined lengths of other segments, setation similar to P 4 except having 4 short medioproximal setae; ischium and merus similar to P 4; carpus slightly longer than propodus, 2 rows of spiniform setae, 5 in each row, along flexor margin and 1 distal spiniform seta near extensor margin; propodus with 6 spiniform setae on flexor margin, 2 distal spiniform setae on extensor margin, 1 distomedial spiniform seta, 3 rows of dendrite spinules on inner face; dactylus as in P 2-4.

Pereopod 6 (Fig. 5H) – Some what similar to P 5, but shorter. Basis shorter than combined length of other segments, 6 or more medioproximal setae present, 2 plumose setae on extensor margin, 1 proximal and 1 distal simple seta on extensor margin;

ischium and merus similar to P 3; carpus equal in length to merus, two rows of spiniform setae, 4-5 in each row; propodus with row of 5 spiniform setae, increasing in size distally, near flexor margin, 1 distal spiniform seta near extensor margin and 1 spiniform seta near distomedial margin, 20 or more dendrite spinules on inner face; dactylus as in P 1-5.

Pleotelson (as in Fig. 1D) – Typical of genus; posteriorly rounded, subovate with small mid-posterior process bearing 2 terminal setae.

Pleopods (Fig. 1C) – 5 similar pairs. Protopod (basis) with 1 long feathered seta distomedially; exopod 1-segmented, 1 feathered proxomedial seta serrated at tip, 4 subterminal feathered setae, 5 terminal feathered setae; exopod 2-segmented, segment 1 with 1 terminal feathered seta, segment 2 with 4 subterminal, 6 terminal feathered setae.

Uropod (Fig. 1B) – Basis about 3 times longer than wide, no setae; exopod 3-segmented, 2 long setae at tip; endopod 10-segmented, segment 1 with 2 distal feathered setae, segment 2 with 1 distal simple seta, segment 3 with 2 distal feathered setae, segment 4

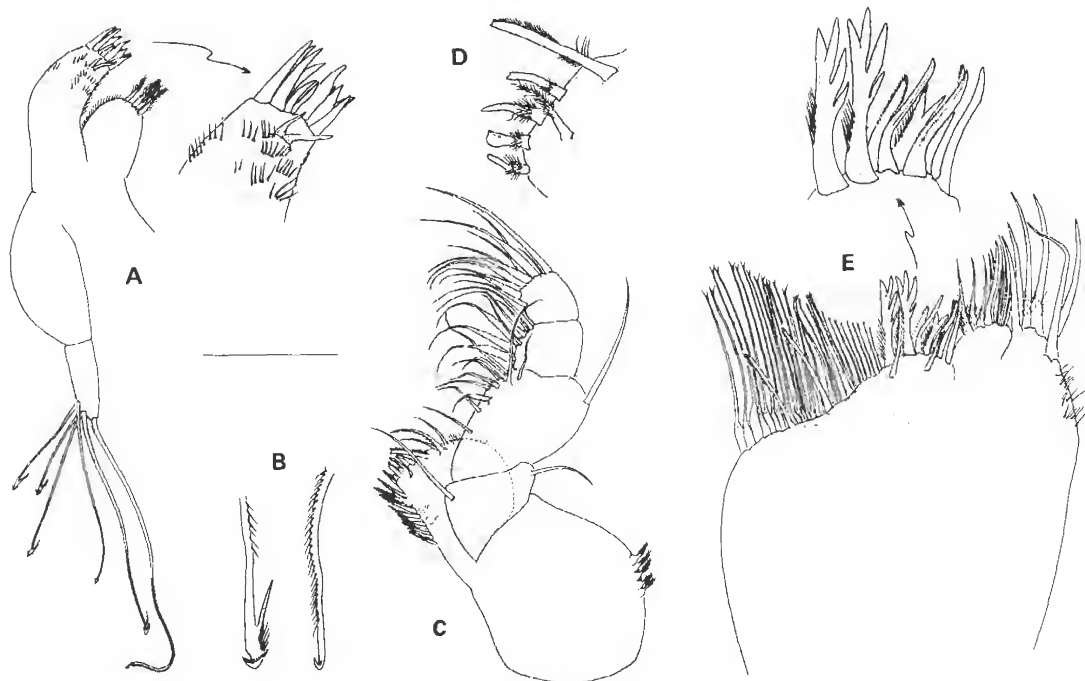


Figure 4. *Pseudosphyrapus siegi* n. sp. Preincubatory female (6.0 mm). (A) maxilla 1 with enlargement of outer endite, (B) tips of a "harpoon-tipped" subterminal seta (left) and unclinate or hook-tipped terminal seta (right) from palp of maxilla 1, (C) maxilliped, (D) enlargement distal part of maxillipedal endite, (E) maxilla 2 with enlargement of spines on fixed endite. Scale = 0.2 mm for A-C; 0.1 for E.

and 5 each with 1 distal simple seta, segment 6 with 2 distal simple setae, segment 8 with 1 very long and 1 short distal seta, segment 10 with 4 long simple and 2 feathered setae at tip.

Preincubatory females (3.7–6.0 mm) – With the exception of incompletely developed oostegites on P 1–5 (Fig. 5C, D, E), they resemble subadult females.

Subadult Males (6.0–6.1 mm) – With the exception of having a small genital cone, the two apparently subadult males from our samples resemble subadult females.

Etymology

The species is named for Jürgen Sieg in recognition of his many contributions to the study of the Order Tanaidacea.

Remarks

The shape of the rostrum immediately distinguishes

Pseudosphyrapus siegi from all other members of the genus. Of the five currently recognized species of *Pseudosphyrapus*, *P. siegi* appears to most be closely related to *P. dispar*, a southwestern Pacific species presently known only from four females, two subadult and two preincubatory, taken at 610 m in the Tasman Sea off New Zealand (Lang 1968). *Pseudosphyrapus siegi* and *P. dispar* appear to be the least derived members of the family, since they still retain a vestigial squama on antenna 2. *Pseudosphyrapus siegi* is distinguished from its southwestern Pacific cognate by: (1) a more triangular, but less acute, rostrum (2) the presence of two 4-pronged spines on the second maxilla (homologous spines on *P. dispar* are 3-pronged), and (3) the absence of a spiniform process on the chelipedal carpus. Other more subtle differences between the two species occur in the setation or spination of the antennae, pereopods and maxilliped.

The following key, modified from Sieg (1986), may be used to separate the species currently assigned to the family Sphyrapidae.

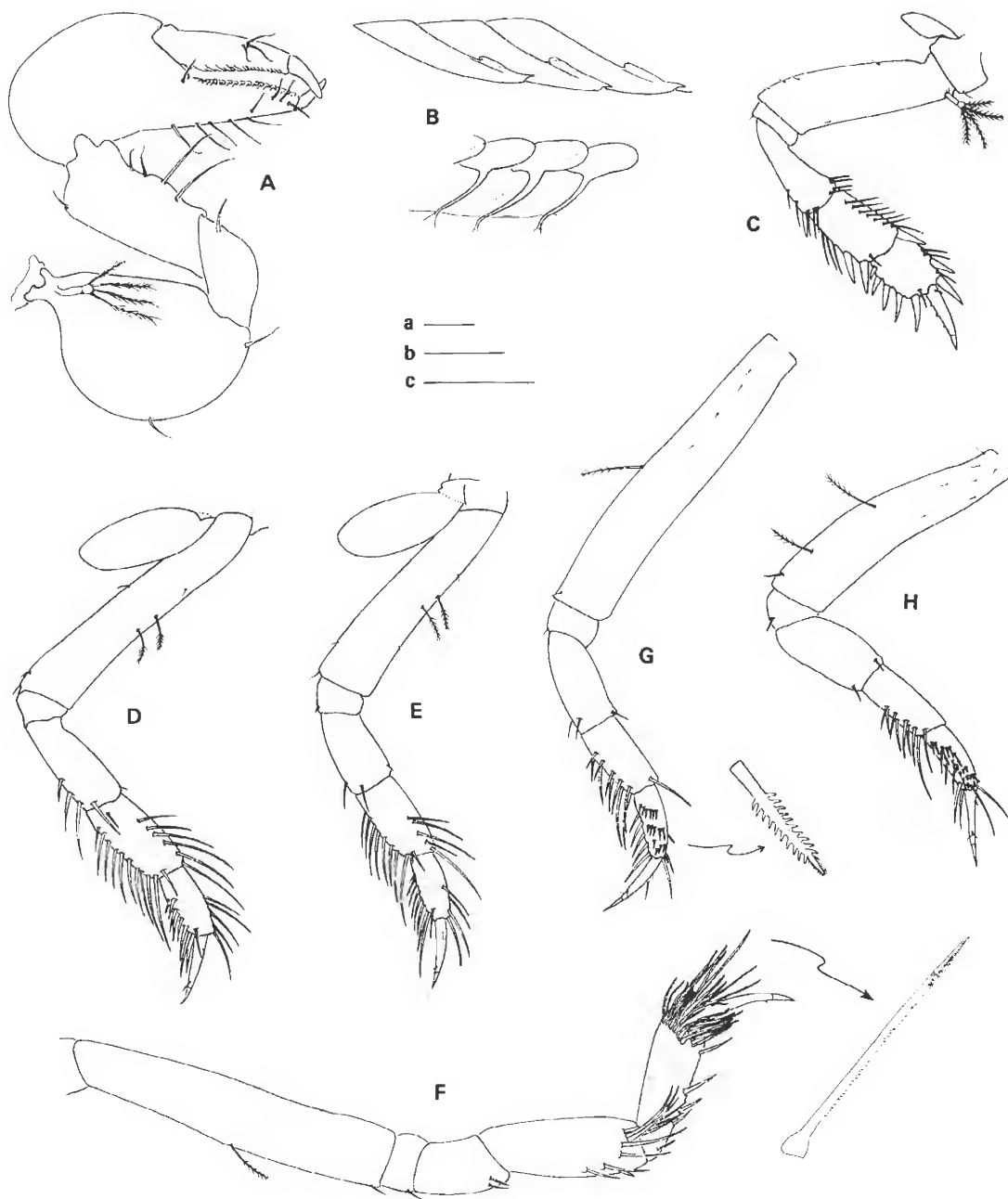


Figure 5. *Pseudosphyrapus siegi* n. sp. Preincubatory female (6.0 mm). (A) right cheliped, (B) enlargement of 3 upper and 3 lower teeth of chela, (C-H) pereopods 1-6 respectively. All scales = 0.4 mm: a for C; b for A; c for D-H.

KEY TO THE SPECIES OF THE FAMILY

1. Mandible without palp, (telson acute posteriorly or with acute posterior process) (subfamily Sphyrarinae Guju, 1980) 2
 Mandible with 3-segmented palp (subfamily Pseudosphyrarinae Guju, 1980) 3
2. Pleonite 2 with lateral margins each armed with large spiniform process *Sphyrapus malleolus* Norman and Stebbing, 1886
 Pleonite 2 with lateral margins unarmed, similar to other pleonites *Sphyrapus tudes* Norman and Stebbing, 1886
3. Antenna 2 without squama on peduncular segment 2 4
 Antenna 2 with small vestigial, 1-segmented squama with long distal seta, on peduncular segment 2 7
4. Uropodal peduncle having lateral margin armed with 2 large setae (1 proximal and 1 distal) *Pseudosphyrapus gutui* Kudinova-Pasternak, 1985
 Uropodal peduncle without 2 large setae 5
5. Rostrum broadly rounded, lacking terminal denticles; last pereonite distinctly broader than first pleonite *Pseudosphyrapus centobi* Băcescu, 1981
 Rostrum with sub-acute tip, having 4 or more minute terminal denticles; last pereonite not distinctly broader than first pleonite 6
6. Pleonites with acuminate, laterally projecting, epimera *Pseudosphyrapus serratus* (G. O. Sars, 1882)
 Pleonites simple and rounded, without acuminate epimera *Pseudosphyrapus anomalus* (G. O. Sars, 1869)
7. Cheliped having carpus armed with spiniform process on extender margin; pleonites with acuminate, laterally projecting epimera *Pseudosphyrapus dispar* Lang, 1968
 Cheliped without spiniform process on carpus; pleonites with rounded lateral margins *Pseudosphyrapus siegi* n.sp.

DISCUSSION

Except for a small genital cone on males and developing oostigites on females, no noticeable sexual dimorphism (e.g., setation of antenna 1, enlargement or modification of chela and pereopod 1 in males) was exhibited by the specimens of *P. siegi* examined. No females of *P. siegi* having fully developed oostigites occurred in our samples; this was also the case for the material of *P. dispar* and *P. centobi* studied by Lang (1968) and Băcescu (1981), both of whom also lacked the male stages of their species. J. Sieg (personal communication) has examined additional material of *P. dispar* and has observed fully developed, sexually dimorphic males for this species. Except for the presence of a genital cone, the two males of *P. siegi* examined during this study were nearly indistinguishable from those females which lacked developing

oostigites. It is probable, however, that more fully developed and sexually dimorphic males such as those now known for *P. anomalus*, *P. dispar*, and *P. serratus* (see Sars 1899, Guju 1980) exist for *P. centobi*, *P. gutui*, and *P. siegi*.

Only two preincubatory females occurred in our material of *P. siegi* from the Gulf of Mexico. The smallest of these (3.7 mm) was collected in relatively shallow water (595 m) where the bottom temperature was 7.5°C, while the larger specimen (6.0) was collected at a depth of 1000 m. The remaining four sub-adult females, which lacked oostigites, ranged in length from 4.0 to 6.0 mm and occurred in depths from 1000 to 2400 m where bottom temperatures were below 5°C. These limited data suggest an increase in body size with depth for *P. siegi*. A similar direct relationship of an increasing body size with depth for populations of *P. cf. anomalus* in the northern Gulf of

Mexico has been observed by one of us (RWH). A larger series of specimens from different depths and additional ecological data (e.g., pressure, sediment composition, bottom temperature) will be needed to determine if there is an overall increase of body size with depth in northern Gulf populations of *P. siegi*.

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LARVAL DISTRIBUTION AND ABUNDANCE OF CARANGIDAE (PISCES), FROM THE SOUTHERN GULF OF MEXICO. 1983-1984.

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ABSTRACT The larval distribution and abundance of several taxa of the carangids from the southern Gulf of Mexico are analyzed, based on data from four oceanographic cruises conducted between 1983 and 1984. The material was collected with a bongo net fished to maximum depths of 200 m. The species collected were *Chloroscombrus chrysurus* (54.2%), *Decapterus punctatus* (15.8%), *Trachurus lathami* (11.8%), *Selene setapinnis* (6.1%), *Selar crumenophthalmus* (6.0%), *Caranx hipposilatus* (0.9%), *Caranx crysos* (0.7%) and *Selene* sp. (0.3%). The higher frequency of occurrence and greater abundance of larvae of all species was found over the continental shelf, and in some cases, in the oceanic zone near the slope. Almost all the species were present year-round with highest larval densities in the warm months, except for *T. lathami* which occurred in greatest abundance during winter and early spring.

INTRODUCTION

Knowledge of early life history can be applied to fishery resource management and is aimed towards three major goals: (1) to identify the spawning areas and seasons; (2) to measure the relative or absolute abundance of the stocks and; (3) to determine those interactions between species during the larval stages that could possibly affect the future size of a stock (Saville 1975).

The major goal of this work does not lead directly to fisheries management; nevertheless, it provides information that could be useful for management of the various carangid fisheries which comprise a vast majority of species with considerable commercial fishery value, especially in tropical and subtropical areas (Abboussuan 1975).

The Carangidae is one of the most abundant families in the southern Gulf of Mexico, and almost all of its species are exploited to some degree. There have been few published accounts of the early life history of carangids in the Gulf of Mexico. McKenney et al. (1958), Aprieto (1974) and Montolio (1976) described the larval development of some species (*Decapterus punctatus*, *Elagatis bipinnulata*, *Selene vomer*, *Oligoplites saurus*, *Seriola zonata* and *Caranx crysos*). Aprieto (1974) and Leak (1977, 1981) reported on their distribution and abundance in the northern Gulf of Mexico, while Montolio (1976) described the distribution of *Decapterus punctatus* and *Caranx crysos* throughout the gulf. Larval carangid occurrence has been noted in some general ichthyoplankton surveys from the southern Gulf of Mexico (Sanvicente-Añorve 1985, Pineda-López 1986, Fajardo-Rivera and Rodríguez-Van Lier 1986). However, there have been

no specific investigations on carangid larvae. The main objective of the present study is to determine the patterns in distribution and abundance of carangid larvae, so as to define spawning seasons and areas.

MATERIALS AND METHODS

The study area is located in the southern Gulf of Mexico, below the 21° N parallel and comprises the continental shelf and adjacent oceanic zone of the states of Veracruz, Tabasco and Campeche (Fig. 1).

Geological, physical and biological aspects of the area can be found in Rossow (1967), Villalobos-Figueroa and Zamora-Sánchez (1975) and Gutiérrez-Estrada (1977).

The zooplankton samples analyzed were collected aboard the oceanographic ship JUSTO SIERRA, during four multidisciplinary oceanographic cruises: PROG-MEX I (spring), March 31 - April 8, 1983; IMECO (winter), February 15-25, 1984; PROG-MEX II (spring), April 25 - May 4, 1984; and PROG-MEX III

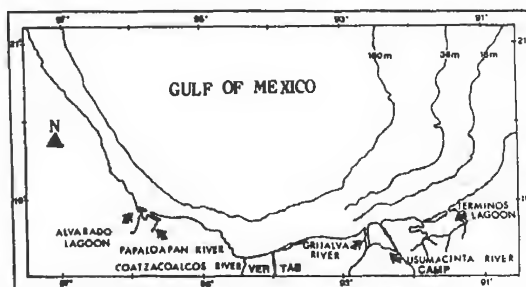


Figure 1. Study area.

(summer), August 7–17, 1984. A total of 172 stations were sampled primarily over the continental shelf zone and, to a lesser extent, the oceanic zone, except for the IMECO cruise which covered a larger portion of the oceanic zone.

Zooplankton sampling consisted of a double oblique plankton tow following a circular course using a bongo net with 333 and 505 μm mesh nets. The water volume filtered was calculated using flowmeters placed in each net. The depth and tow time varied from 10 to 200 m and from 2 to 23 min., respectively, according to the bathymetry.

Larval density (L) was standardized and reported as number of larvae/100 m^3 . As two samples were available for each station, resulting from the 333 and 505 μm nets, the highest value of L for the quantitative analysis was always taken, independently of the mesh.

RESULTS

A total of 3,610 carangid larvae were collected. These corresponded to eight (or nine) species, of which *Chloroscombrus chrysurus* was the most abundant (54.2%), followed by *Decapterus punctatus* (15.8%), *Trachurus lathami* (11.8%), *Selene setapinnis* (6.1%), *Selar crumenophthalmus* (6.0%), *Caranx hipposyllatus* (0.9%), *Caranx crysos* (0.7%) and *Selene* sp. (0.3%). Data on these species are presented below (Table 1).

Chloroscombrus chrysurus (Linnaeus, 1776) "Atlantic bumper"

This species was distributed throughout the study area. It was the most frequent and abundant species

(Table 1). Atlantic bumper was abundant over the eastern continental shelf and virtually absent in the western portion.

Greatest abundance was observed in shallow waters less than 40 m deep, near the fluvial-lagoon systems, with highest larval densities occurring in front of Términos Lagoon (Fig. 2).

Though scarce during winter, the presence of larvae in all four cruises indicates that spawning occurs year-round. Maximum spawning appears to occur especially during summer and the warm months of spring.

Decapterus punctatus (Agassiz, 1829) "Round scad"

Round scad larvae were widely distributed in the study area. They occurred mainly over the continental shelf in areas less than 100 m deep, where greatest abundances were found. In deeper areas, they were scarce and less frequently taken (Fig. 3).

The larvae of this species were taken most frequently in the eastern region of the sampling area. They were scarce and less frequent on the Veracruz shelf except during the March–April cruise in 1983, where the greatest abundance and highest frequency of occurrence were observed at the mouth of the Coatzacoalcos River.

This species also appeared to spawn year-round with the lowest intensity during cold months (winter) and the highest during warm months (spring–summer), particularly during spring.

Trachurus lathami Nichols, 1920 "Rough scad"

The larvae of *T. lathami* were widely distributed throughout the sampled area. The greatest abundance

TABLE 1

Abundance, frequency and size range of carangid larvae, during four cruises in the southern Gulf of Mexico. A. - Percentage of occurrence; B. - Larval density (No. larvae/100 m^3)

	PROGMEX I 48 stations		IMECO 29 stations		PROGMEX II 40 stations		PROGMEX III 55 stations		TOTAL B	% B	Size range mm
	A	B	A	B	A	B	A	B			
<i>Chloroscombrus chrysurus</i>	22.9	79.4	10.3	22.1	32.5	305.4	50.9	403.0	809.9	54.2	1.8–13.3
<i>Decapterus punctatus</i>	20.8	56.5	10.3	5.7	37.5	140.7	25.5	33.5	236.4	15.8	1.4–13.8
<i>Trachurus lathami</i>	54.2	125.6	44.8	34.4	12.5	14.6	5.5	1.6	176.2	11.8	2.1–12.4
<i>Selene setapinnis</i>	27.1	29.0	3.4	0.7	25.0	39.7	36.4	21.9	91.3	6.1	1.7–11.4
<i>Selar crumenophthalmus</i>	29.2	37.6	3.4	0.5	30.0	22.3	38.2	29.4	89.8	6.0	2.1–14.3
<i>Caranx hipposyllatus</i>	0	0	0	0	10.0	7.4	20.0	6.4	13.8	0.9	3.1–6.3
<i>Caranx crysos</i>	0	0	0	0	5.0	2.3	12.7	8.7	11.0	0.7	3.1–7.8
<i>Selene</i> sp.	0	0	0	0	5.0	2.4	5.5	2.1	4.5	0.3	2.9–5.6
Indeterminate	0	0	0	0	10.0	9.0	41.8	53.8	62.8	4.2	1.6–2.5

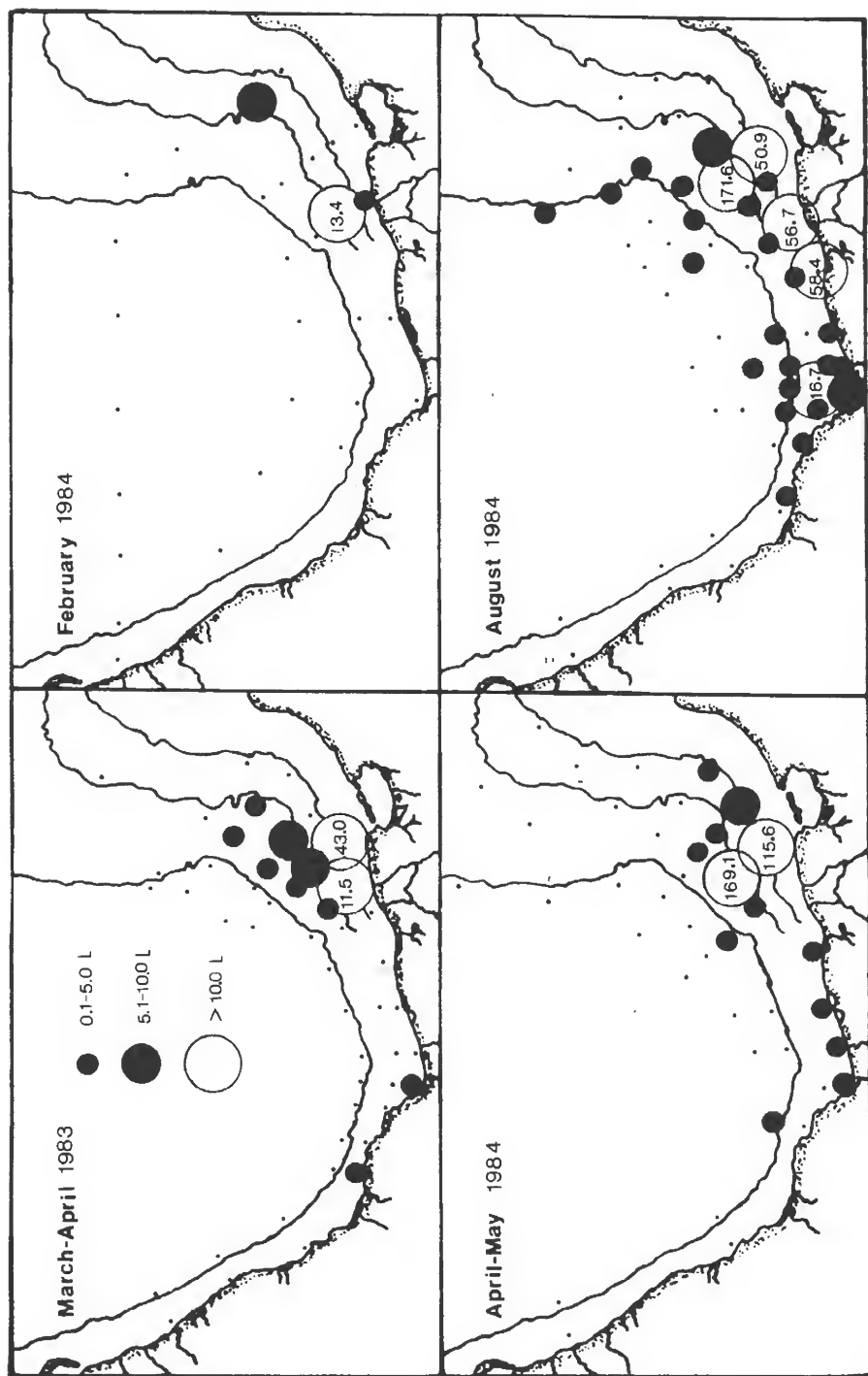


Figure 2. Abundance and distribution of *Chloroscombrus chrysurus*. Southern Gulf of Mexico.

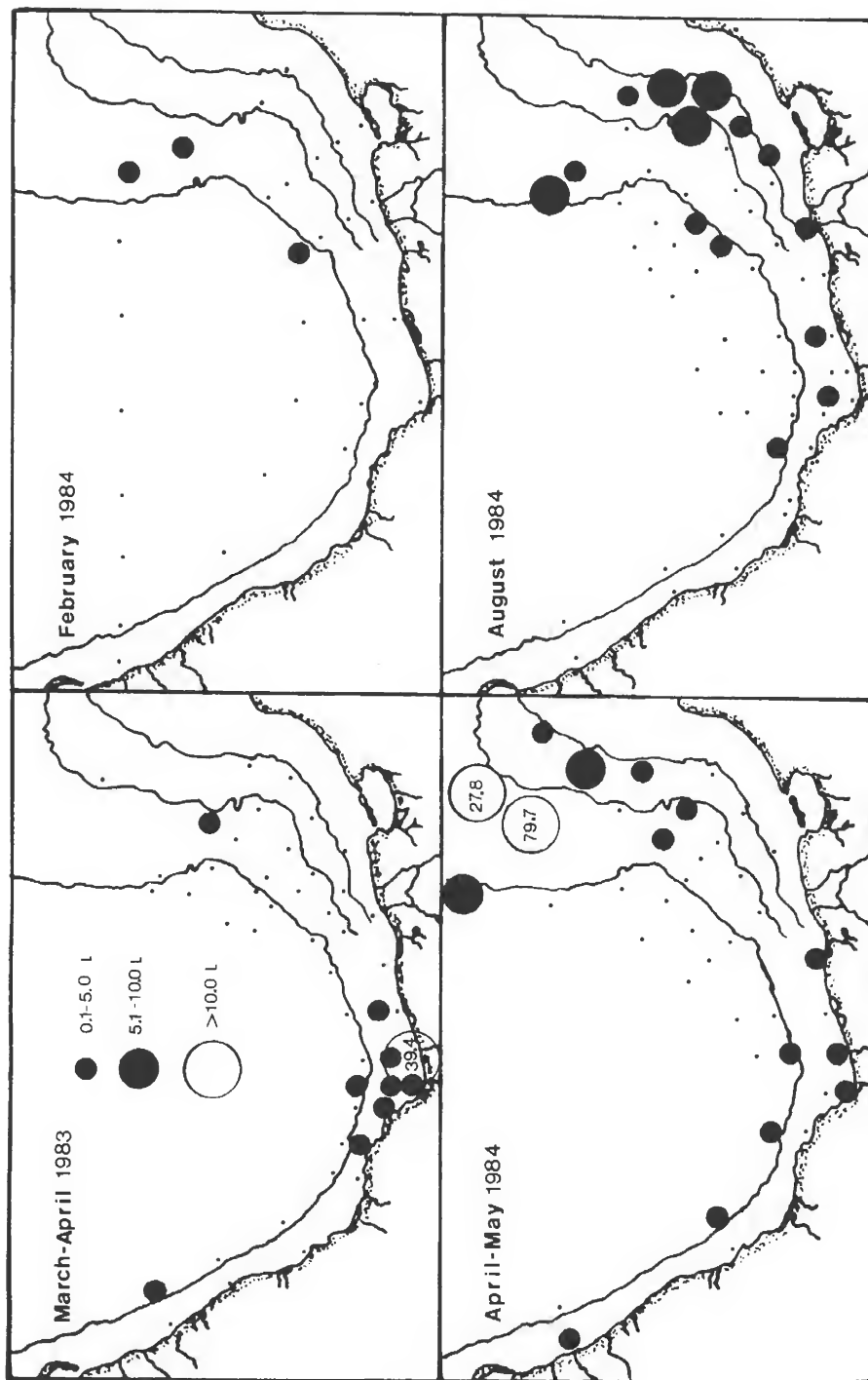


Figure 3. Abundance and distribution of *Decaplerus punctatus*. Southern Gulf of Mexico.

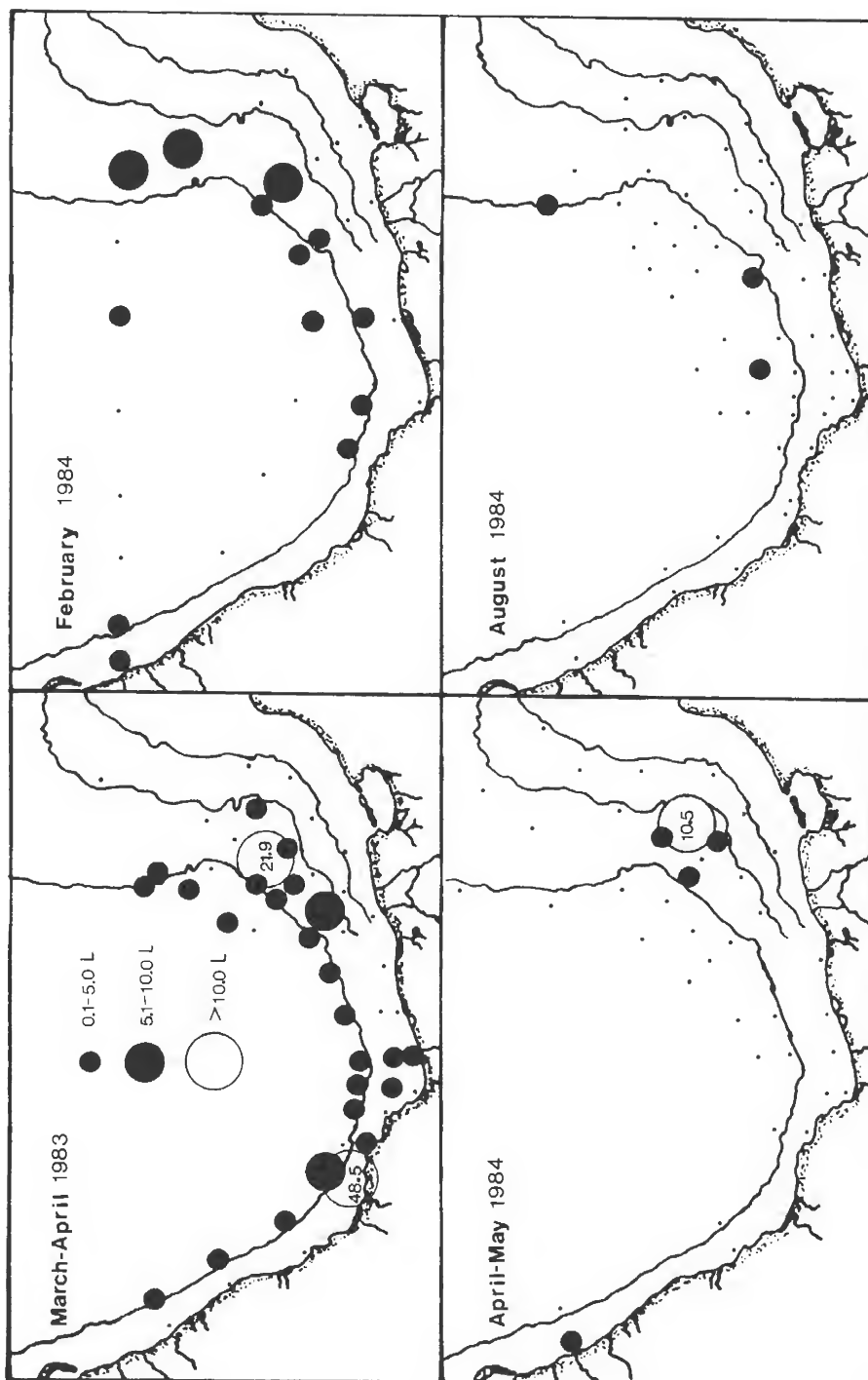


Figure 4. Abundance and distribution of *Trachurus lathami*. Southern Gulf of Mexico.

was found over the continental shelf at depths > 36 m, with the exception of the western region, where the shelf is narrower and where the larvae occurred at stations less than 36 m deep (Fig. 4). Though less abundant, they were frequently taken at the shelf break and were scarce in the oceanic zone.

Larvae were taken on all four cruises, but were least abundant during summer months. This species probably spawns year-round, peaking during the winter-spring seasons, mainly in early spring.

Selene setapinnis (Mitchill, 1815)
"Atlantic moonfish"

Atlantic moonfish larvae were widely distributed throughout the eastern portion of the survey area, with the highest frequency of occurrence and greatest abundance observed along the Tabasco and Campeche coasts (Fig. 5). Larvae of this species were most often found in areas over the continental shelf at depths > 40 m, although some larvae were captured in shallower stations as well as in some oceanic areas close to the continental slope.

Larvae were present throughout the year, with the greatest abundance occurring during the warm months of spring and summer.

Selar crumenophthalmus (Bloch, 1793)
"Bigeye scad"

The larvae of this species were distributed throughout the study area, mainly over the continental shelf, where major centers of abundance were found at depths > 36 m. A few larvae occurred in the oceanic zone along the shelf break (Fig. 6).

These data indicate that this species spawns over the mid to outer shelf. The presence of larvae within the coastal zone was limited to the western part of the study area, where the shelf is very narrow. This may be a consequence of local currents transporting larvae shoreward.

Bigeye scad larvae were captured on all four cruises; hence, it can be concluded that this species spawns year-round, with a peak in spring-summer months.

Caranx hippos/latus (Linnaeus, 1766)
"Jack crevalle"

The larvae of *C. hippos* and *C. latus* cannot be distinguished from each other.

Larvae of this complex had a wide distribution in the study area, present mainly in offshore waters over the shelf. They were least abundant at the Veracruz shelf and in the oceanic zone (Fig. 7A).

Larvae were collected only in spring (April-May) and summer.

Caranx crysos (Mitchill, 1815)
"Blue runner"

The larvae of this species occurred in low abundance throughout the survey area, collected more frequently at stations that were > 40 m in depth, including the oceanic ones. The coastal stations where they were captured were all located in the narrow shelf of Veracruz. Occurrence was limited almost exclusively to the summer cruise, with only four specimens captured during spring (Fig. 7B).

It appears that *C. crysos* spawns at the outer shelf and oceanic areas. Its presence in coastal waters of Veracruz can probably be explained by the narrowness of the shelf, allowing the larvae to be easily carried inshore from the oceanic zone by local currents. The spawning season takes place, primarily, in summer.

Selene sp. (Agassiz)
"Full moonfish"

Only three species of *Selene* (*S. vomer*, *S. setapinnis* and *S. brownii*) have been recorded in the western Atlantic and Gulf of Mexico (Berry and Smith-Vaniz 1978, Laroche et al. 1984).

The larvae referred to in this paper as *Selene* sp. do not correspond to either the *S. vomer* or the *S. setapinnis* described; therefore, they could possibly correspond to *S. brownii*.

Larvae of this species were scarce, present in shelf waters of Tabasco and Campeche from the coastal zone to the slope. They occurred only during spring and summer, with five and three larvae captured, respectively (Fig. 8).

DISCUSSION AND CONCLUSIONS

Larvae of eight (or nine) of the 15 species of carangids recorded as adults in the southern Gulf of Mexico by Castro-Aguirre (1978), Berry and Smith-Vaniz (1978), Reséndez-Medina (1970, 1973, 1981), and Sánchez-Gil et al. (1981) were found in our study area. *Chloroscombrus chrysurus* was the most abundant among the captured species (54.2%); followed by *Decapterus punctatus* (15.8%), *Trachurus lathami* (11.8%), *Selene setapinnis* (6.1%), *Selar crumenophthalmus* (6.0%), *Caranx hippos/latus* (0.9%), *Caranx crysos* (0.7%), and *Selene* sp. (0.3%). Larvae of *Trachinotus falcatus*, *T. carolinus*, *Selene vomer*, *Hemicaranx amblyrhynchus*, *Caranx bartholomaei* and *Oligoplites saurus* were absent. Larvae of the *O. saurus* have been reported for the Términos Lagoon (Flores-Coto and Alvarez-Cadena 1980, Flores-Coto 1985, Ferreira-González and Acal-Sánchez 1984).

Larval distribution and abundance studies of carangids from the northern Gulf of Mexico found that the most abundant species were *D. punctatus*, *C. chrysurus* and *T. lathami* (Leak 1977, 1981), which correspond

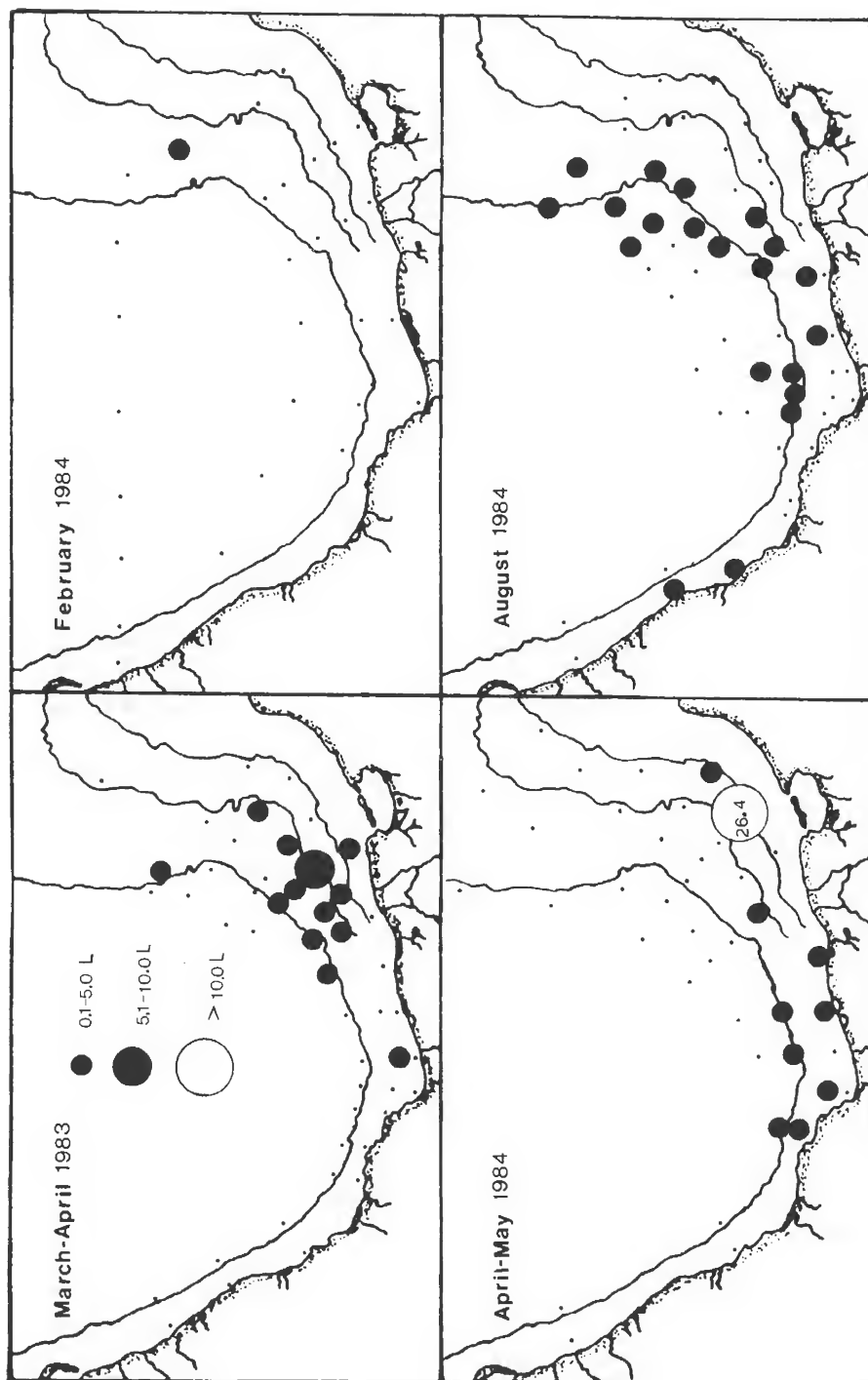


Figure 5. Abundance and distribution of *Selene setipinnis*. Southern Gulf of Mexico.

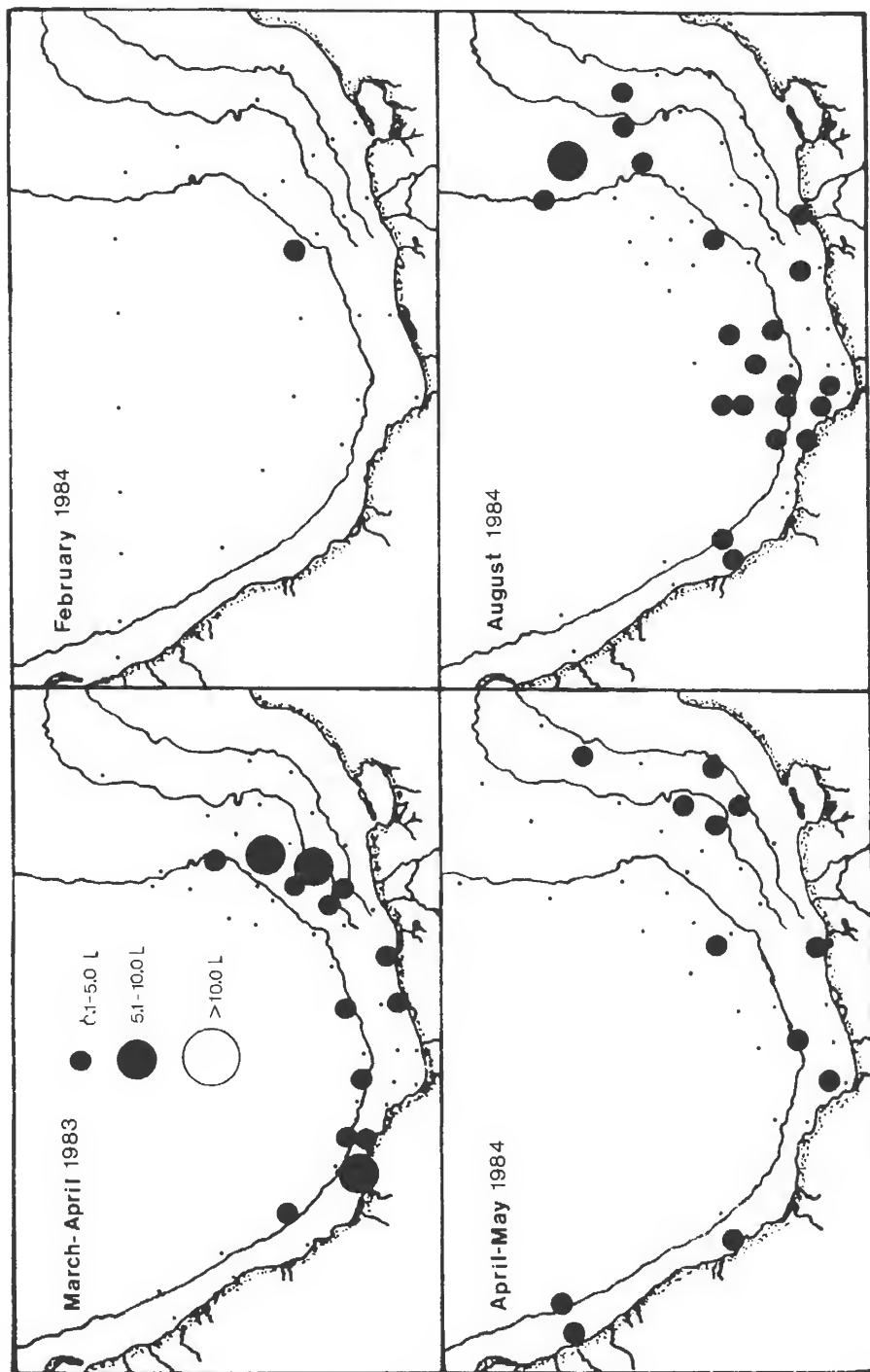


Figure 6. Abundance and distribution of *Sclerocrumenophthalmus*. Southern Gulf of Mexico.

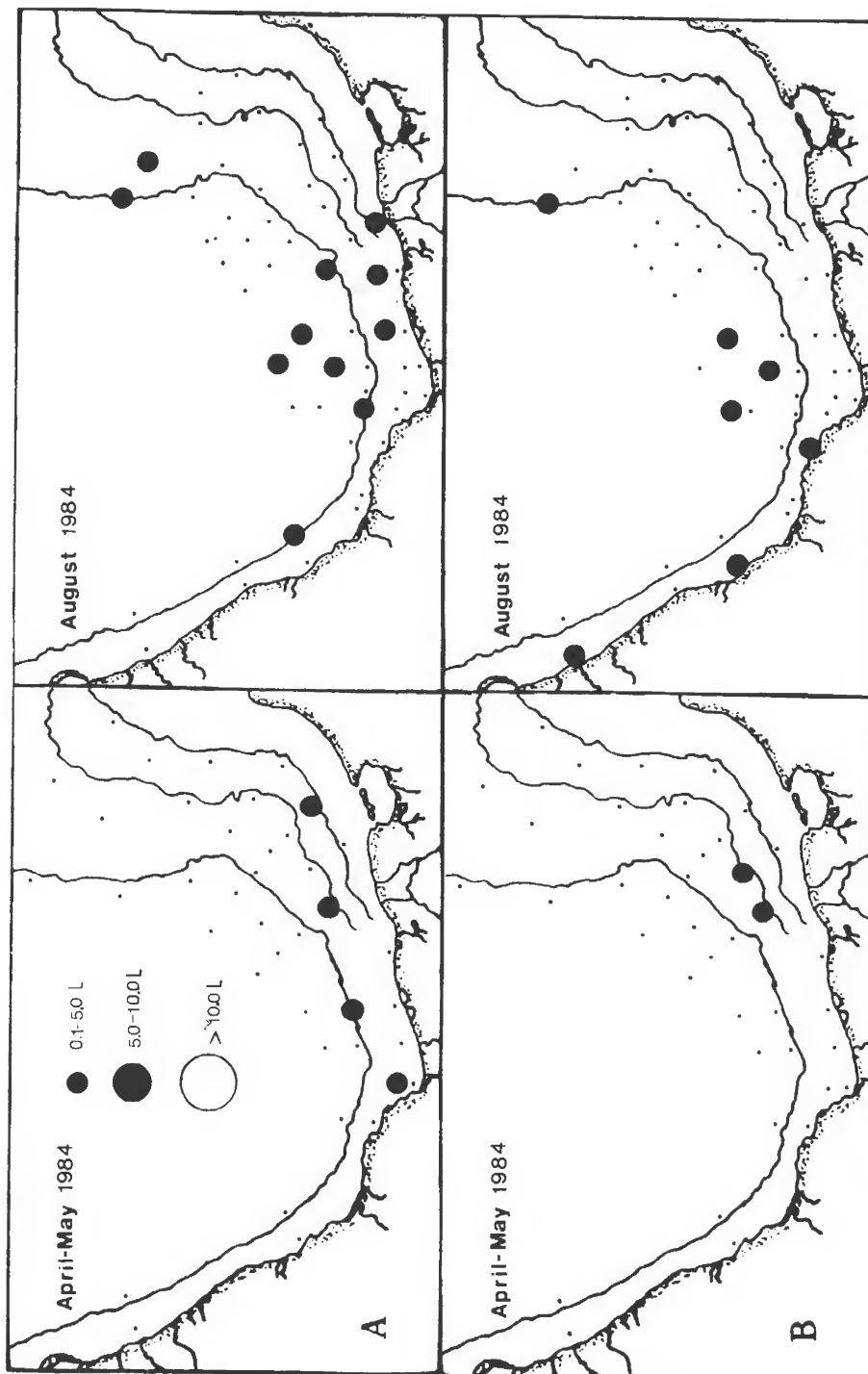


Figure 7. Abundance and distribution of: (A) *Caranx hippos/latus*, (B) *Caranx crysos*. Southern Gulf of Mexico.

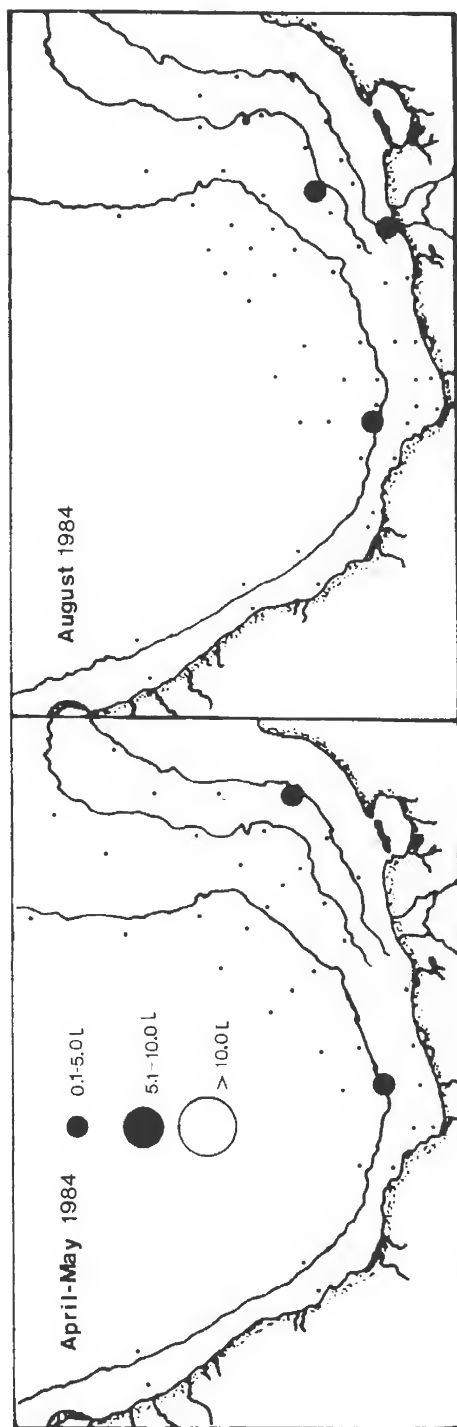


Figure 8. Abundance and distribution of *Selenia* sp. Southern Gulf of Mexico.

with those most abundant (80%) in our study area (*C. chrysurus*, *D. punctatus* and *T. lathami*).

Larvae of *D. punctatus* were reported as the most abundant species in the Gulf of Mexico (Montolio 1976, Aprieto 1974).

There is a partial correspondence of the abundance of larvae and adults in our study area. *Chloroscombrus chrysurus* and *T. lathami* were the first and third most abundant species, and their adults are referred to as the second and first most abundant species respectively (Sánchez-Gil et al. 1981). On the other hand, according to Castro-Aguirre (1978), *C. crysos* is an abundant species in this area; nevertheless, the larvae were rare in our study. This may have resulted from the species spawning in offshore waters (Berry 1959, Montolio 1976, Leak 1977), where the number of stations was limited.

Carangid larvae were most abundant and occurred at high frequencies over the continental shelf, though high frequencies were also observed in the oceanic zone generally near the slope. All the species were shown to spawn in neritic waters, but there were some differences among them in relation to their general distribution and areas of highest concentration. For example, *S. crumenophthalmus*, *D. punctatus* and *T. lathami* were the best represented on the Veracruz shelf, but like most of the species, their highest abundances were still over the eastern portion of the study area. *Chloroscombrus chrysurus*, *D. punctatus* and *S. setapinnis* had their highest densities to the east of the Grijalva-Usumacinta system.

None of the species were exclusively coastal in distribution. Only *C. chrysurus* could be considered to be a coastal species, with greatest densities found where water depths were < 40 m, mainly in front of the Términos Lagoon, where their larvae are considered common (Flores-Coto and Alvarez-Cadena 1980, Flores-Coto 1985). The spawning in coastal areas is also referred to by Leak (1977, 1981) and Houde et al. (1979). Also, higher abundance of adults has been recorded in the southern Gulf of Mexico around the 18 m isobath (Sánchez-Gil et al. 1981).

The remaining species had their highest frequency of occurrence and greatest abundance on the mid shelf

40–100 m depth (*D. punctatus* and *S. setapinnis*), or on the outer shelf (*C. hipposlatus* and *C. crysos*), which closely corresponds with reports from the northern Gulf of Mexico and southeast United States (Berry 1959; Aprieto 1974; Montolio 1976; Leak 1977, 1981; and Wang and Kemehehan 1979).

The larvae distribution of *S. crumenophthalmus* shows different aspects between west Florida, where they are present in the outer shelf over the 150 m isobath, and the Hawaiian Islands, where they occur at the coastal zone (Leak 1977). In the southern Gulf of Mexico, this species spawns in the inner and outer regions of the shelf.

The majority of the species occurred throughout the year, with highest densities of *S. crumenophthalmus* and *S. setapinnis* during the warm period of spring-summer, *C. chrysurus* was particularly abundant in summer and *D. punctatus* in spring. *Selene* sp., *C. hipposlatus* and *C. crysos*, the least abundant species, were present only in spring and summer.

Our data closely correspond to the spawning seasons of this species in the northern Gulf and southeastern United States (Berry 1959; Aprieto 1974; Montolio 1976; Leak 1977, 1981; Berry and Smith-Vaniz 1978; Houde et al. 1979; and Wang and Kemehehan 1979).

Among the carangids collected, *lathami* were the only larvae which were most abundant during winter and at the beginning of spring. In the northern Gulf, larvae of this species, which is considered a winter spawner, have been collected from November through May (Leak 1977, 1981).

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Calliax jonesi, N. Sp. (Decapoda: Thalassinidea: Callianassidae) from the Northwestern Bahamas

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CALLIAX JONESI, N. SP. (DECAPODA: THALASSINIDEA: CALLIANASSIDAE) FROM THE NORTHWESTERN BAHAMAS

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ABSTRACT Two specimens of *Calliax jonesi*, n. sp., were collected from fine carbonate sediments in 3 to 5 m of water at Bimini Harbor, Bahamas. Of the species presently assigned to the genus *Calliax* de Saint Laurent, 1973, *C. jonesi* appears to be most closely related to *C. quadracuta* (Biffar, 1970), presently known from the Atlantic coast of Venezuela and the Florida Keys. *Calliax jonesi* is distinguished from *C. quadracuta* by: (1) the absence of a distal spinose process on the dorsal and ventral margins of the carpus of the first pair of chelipeds, (2) the armature and shape of uropods and telson, and (3) the shape of male first pleopod. *Calliax jonesi*, *C. quadracuta*, and at least two undescribed species from the northwestern Atlantic appear to form a closely related species complex which may not be congeneric with the type species, *C. lobata* (de Gaillande & Lagardère, 1966), and other species assigned to *Calliax*.

INTRODUCTION

Manning and Heard (1986) reported *Callianassa branneri* Rathbun, 1900, now considered synonymous with *C. grandimanus* Gibbes, 1850 (see Manning 1987), and *C. rathbunae* Schmitt, 1935 from the Florida East Coast and Bimini Harbor, Bahamas. In their report they also mentioned the presence of "an undescribed species, closely related to *C. quadracuta* Biffar," in the collection from Bimini. The description of this new species, which is here tentatively placed in the genus *Calliax* de Saint Laurent, 1973, is the subject of the present report.

Calliax jonesi, new species

Figures 1-5

Synonymy: "Undescribed species" Manning and Heard (1986): 347.

Material examined

Holotype - (National Museum of Natural History, USNM 221861), ♂ - carapace length (CL) = 9.8 mm; Bimini Harbor, Bahamas (west side of harbor approximately 100 m north of seaplane ramp), 25°44'N; 079°15'W; depth 3-5 m on carbonate sand-silt substratum; collected with suction pump device (see Manning 1975); 2 October 1980; R. W. Heard, collector.

Paratype - (GCRL 1136), ♂ - CL = 9.6 mm; same collection data as holotype.

Diagnosis - Rostrum distinct, acute, longer than wide, extending approximately 1/2 length of eye stalks.

Dorsal carapace with dorsal oval and cervical groove indistinct. Chelipeds of first pereopods subequal, dissimilar; carpus of both chelae without dorsodistal or ventrodistal acute processes; propodus of both chelae without dorsodistal acute process; merus unarmed; ischium with ventral margin armed with row of 10-12 spines, increasing in size distally. First male pleopod 2-segmented; terminal segment with a lateral, anteriorly directed, hook-shaped, apical process and a medial, weakly bidentate, subapical process. Endopod of uropod blunt distally. Telson approximately twice as wide as long; proximal half with strong transverse, distally sloping ridge, interrupted medially by distinct notch; posterior margin laterally excavate on each side of midregion.

Description of male

Carapace (Figures 1, 3A, D) - Rostrum acute, extending approximately 1/2 of visible length of eye stalks; lateral projections absent. Dorsal carapace with length less than combined lengths of pleonites 1 and 2; front, dorsal oval, and cervical groove indistinctly defined (Figure 3A); suture lines arising in mid-region of branchiostegites, joining dorsally in anterior region of posterior third of carapace (Figure 3D); margins of branchiostegites and posterior margin of dorsal carapace fringed with setae, surface of branchiostegites sparsely setose, mid-ventrolateral area with network of shallow sinuses (Figure 3D).

Eye stalks (Figure 3B) - Dorsoventrally flattened, extending beyond distal margin of first segment of antennular peduncle, over 2 times longer than wide, subdistal margins (at level of visual elements) tapering dorsolaterally to subacute point; visual elements

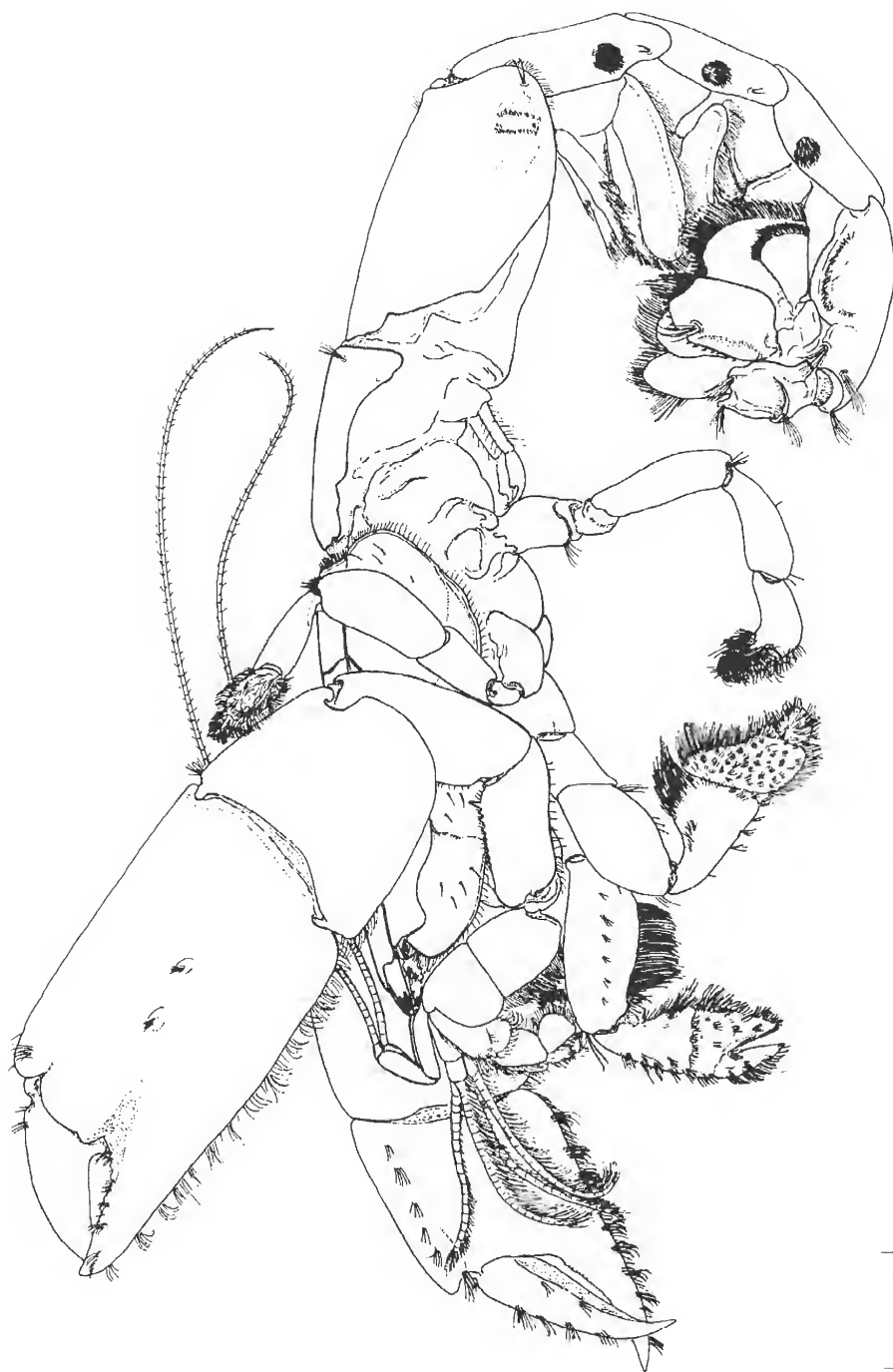


Figure 1. *Calliar jonesi*, n. sp. Lateral view of male holotype. Scale = 3 mm.

relatively well developed, darkly pigmented.

Antennule (Figure 1) – Length of peduncle segment 3 about 0.6 times that of 2. Flagella nearly equal in length; dorsal flagellum having 26–28 setose articles, greatest diameter subdistally between articles 17–19, 8 articles preceding terminal article bearing aesthetascs; ventral flagellum having 20–21 setose articles gradually decreasing in diameter distally.

Antenna (Figure 1) – Peduncle over-reaching antennular peduncle, extending distally to about article 5 of ventral antennular flagellum; flagellum having 95–98 articles, extending posteriorly past pleonite 1.

Pleonites (Figure 1) – First pleonite strongly constricted anteriorly (appearing subtriangular dorsally), pair of small setal tufts near posterodorsal margin. Second pleonite subquadrate, narrowest anteriorly, 1.3 times longer than first pleonite, circular patch of small setae near ventral margin of posterolateral border, a few setae along dorsal and ventral posterior margins. Third pleonite about as long as first pleonite, setation similar to second pleonite except circular patch of setae more centrally located on ventral margin. Fourth and fifth pleonites similar to third pleonite, but slightly shorter. Sixth pleonite broadest anteriorly, approximately same length as first pleonite, more setose than pleonites 1–5; small suture on posterior 1/3 of each lateral margin; mid-dorsal suture or groove opening on posterior margin, extending anterodorsally approximately 1/7 length of somite before closing to form indistinct, mid-dorsal line disappearing on anterior 1/4 of somite; setation as figured (1, 3E).

Mouthparts (Figure 2A–D) – Mandible, maxilla 1, and maxilla 2 as figured.

Maxillipeds (Figures 2E–F, 4F) – Maxilliped 1, as figured, typical. Maxilliped 2 with greatly reduced, vestigial, podobranch; exopod relatively broad, reaching distal end of article 2 of endopod; endopod, penultimate segment bearing cluster of simple spine-setae of various sizes on inner face of distal 1/2, terminal bearing 8–9 distal and subdistal serrate, spoon tipped, spine-setae of various sizes. Maxilliped 3, lacking exopod, relatively stout; mesial surface of ischium with curved, irregularly spaced, row of 9–10 small teeth; merus approximately 3/4 length of ischium; propodus with large, deep lobe on flexor margin, broadest proximally, nearly as broad as long; dactyl blunt, subquadrate, greatest width in distal half, width 4/5 length.

Pereopods 1–5 (Figure 4 A–E, G–J) – First pereopods with chelae strongly developed, subequal, but dissimilar, setation as illustrated; ischium of both pereopods similar, relatively short, ventral margin armed with row of 11–12 spines increasing in size distally; merus of both pereopods unarmed; carpus of both pereopods lacking dorsodistal or ventrodistal spine teeth; propodus of both pereopods without dorsodistal spine tooth, dorsodistal margin on smaller chela produced into short blunt process, no such process on larger chela, shallow groove originating distally be-

tween fingers and extending into distal 1/4 of palm on both chelae, inner face of palm with blister-like structure present proximally near proximal margin on larger (left) chela of holotype. Left chela (Figure 4B) larger and more robust than right; fixed finger with subacute tip, proximal 1/2 of cutting edge raised, finely denticulate with 2–3 small notches; movable finger (dactyl) as long as fixed finger, about 1/2 length of palm, having a single rounded tooth on proximal 1/2 of cutting edge. Right chela (Figure 4A) with fixed finger terminally acute having proximal 1/2 of cutting edge finely, but irregularly, denticulate; movable finger as long as fixed finger, about equal in length to palm, cutting edge sharp, beveled, without teeth or fine denticles. Second, third, and fourth pereopods as figured (Figures 1, 3), typical of genus. Fifth pereopod longer and having fewer proximal setae on propodus than fourth; weakly chelate fixed finger or process with rounded finely toothed cutting edge, much shorter than dactyl; dactyl with medial cavity to accommodate fixed process of propodus.

Pleopods – First male pleopod (Figure 5A, B) 2-segmented; terminal segment with lateral, anteriorly directed, hook-shaped, apical process and a medial, weakly bidentate, subapical process. Pleopods 2 and 3 as figured (Figure 5C, D); 4–5 similar to 3.

Uropods (Figures 1, 3E) – Endopod of uropod about 1.8 times longer than wide, extending well beyond telson, distal margin nearly straight with dense cluster of setae, inner margin bearing row of small, short, widely separated setae. Exopod broad, suboval not extending as far posteriorly as endopod; upper plate well developed, armed with dense setae distolaterally and cluster of 8–9 stout spine setae on distomedial margin; suture distinct; lower plate with distal margin densely setose, distomedial margin with row of 13–15 stout spine setae increasing in size medially.

Telson (Figures 1, 3E) – Approximately twice as wide as long; anterior half with strong, transverse, posteriorly sloping ridge, interrupted medially by distinct notch; shallow medial depression extending and expanding posteriorly from notch to posterior margin; posterior margin laterally excavate or weakly trilobed; setation as illustrated.

Female – Unknown.

Etymology

This species is named for Dr. Jim Jones, Director, Mississippi-Alabama Sea Grant Consortium, in recognition of his many contributions to the study and understanding of the marine environment.

REMARKS

In addition to *C. jonesi*, six species are presently assigned to the genus *Calliax* (see de Saint Laurent

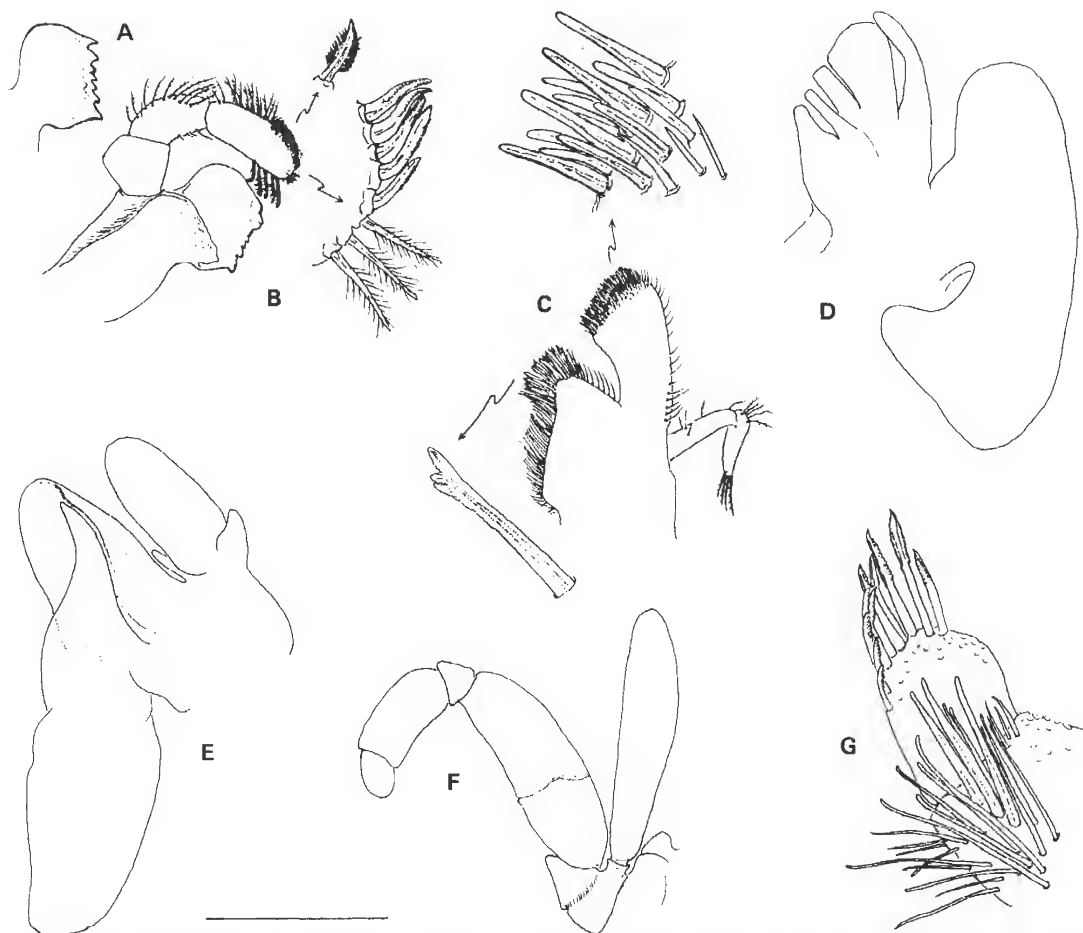


Figure 2. *Calliax jonesi*, n. sp. (setation omitted on D-F). (A) right mandible of paratype, lateral aspect; (B) left mandible of holotype with palp, medial aspect; (C) maxilla 1; (D) maxilla 2, (E) maxilliped 1; (F) maxilliped 2; (G) medial aspect of endopod of maxilliped 2 showing serrate, spoon tipped, spine-setae on terminal segment and simple spine-setae on penultimate segment, plumose setae omitted. Scale = 1.0 mm for A-F; 0.4 mm for G.

and Le Loeuff 1979, de Saint Laurent and Manning 1982). These include *C. novaebritanniae* (Borradaile, 1900); *C. aequimana* (Baker, 1907); *C. quadracuta*, *C. sakaii* de Saint Laurent, 1979; *C. punica* de Saint Laurent and Manning, 1982; and the type species, *C. lobata* (de Gaillande and Lagardère, 1966). *Calliax novaebritanniae*, *C. punica* and *C. sakaii* are distinguished from *C. jonesi* by the presence of an exopod on maxilliped 3. Of the remaining species, all of which lack an exopod on the third maxilliped, *C. jonesi* appears to be most closely related to *C. quadracuta*, known from the Atlantic coasts of Venezuela and South Florida (Biffar 1970, 1971). *Calliax jonesi* is distinguished from *C. quadracuta* by: (1) carpus of the second pair of chelipeds lacking acute distal pro-

cesses or spines on dorsal and ventral margins, (2) armature and shape of uropods and telson, and (3) shape and setation of male first pleopod. The strongly developed transverse telsonic ridge, unarmed merus of the larger first cheliped, and the "typically" developed smaller first cheliped of *C. jonesi* distinguish it from the type species, *C. lobata* which is known from the Mediterranean. *Callianassa aequimana* Baker, 1907 (sensu Poore and Griffin 1979), an Australian species, differs from *C. jonesi* in several characters including the reduced spination of the merus of the first chelipeds and the spination and shape of the uropods and telson.

Calliax jonesi, *C. quadracuta*, and at least two undescribed species from the northwestern Atlantic

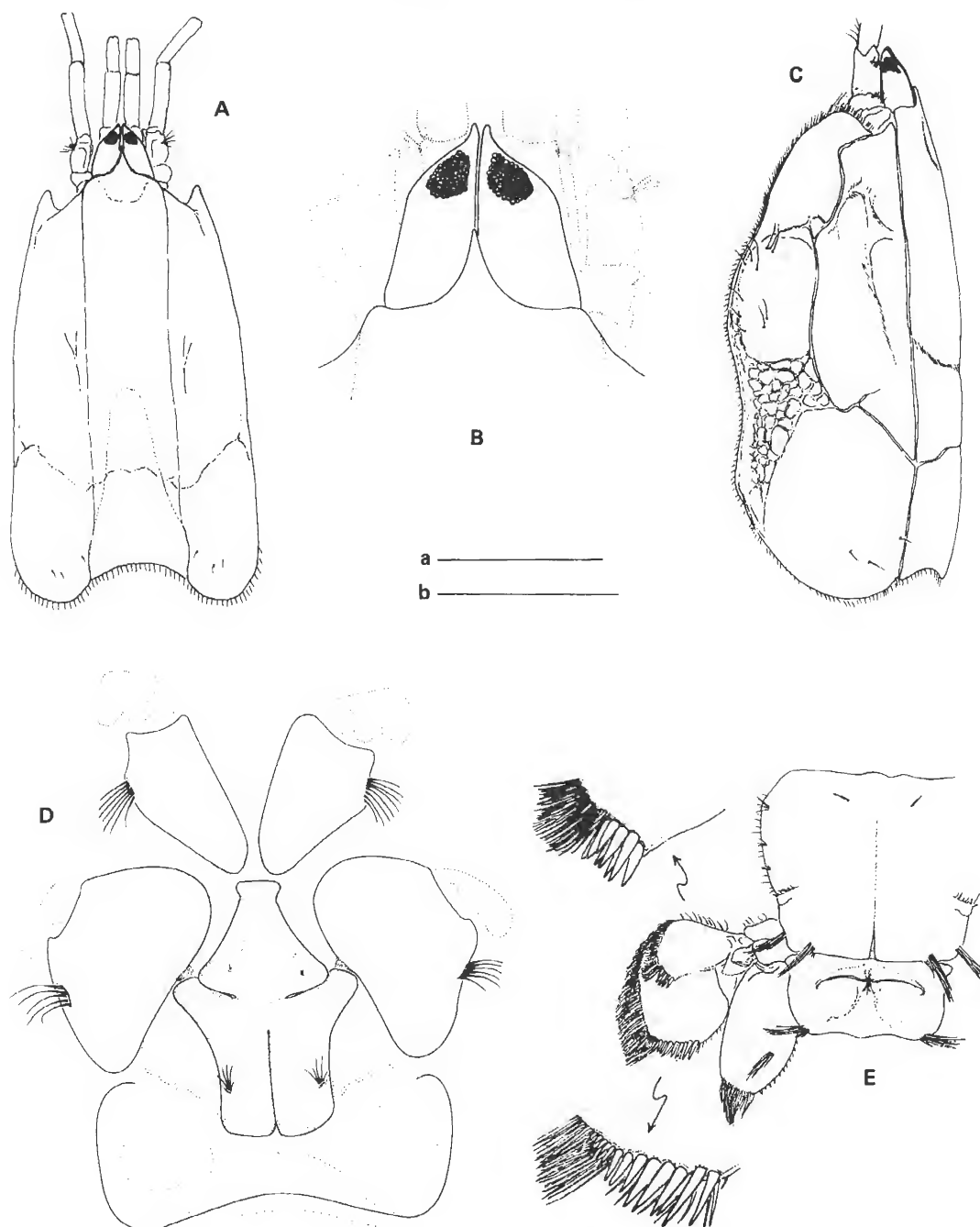


Figure 3. *Callixa jonesi*, n. sp. A-B, D-E paratype; C holotype. (A) carapace, dorsal aspect; (B) eye stalks and rostrum; (C) carapace, lateral aspect; (D) mid-sternal plate; (E) dorsal view of pleonite 6, telson, and uropods. Scale a = 4.0 mm (A), 2.0 mm (B, D); b = 4.0 mm (C, E).

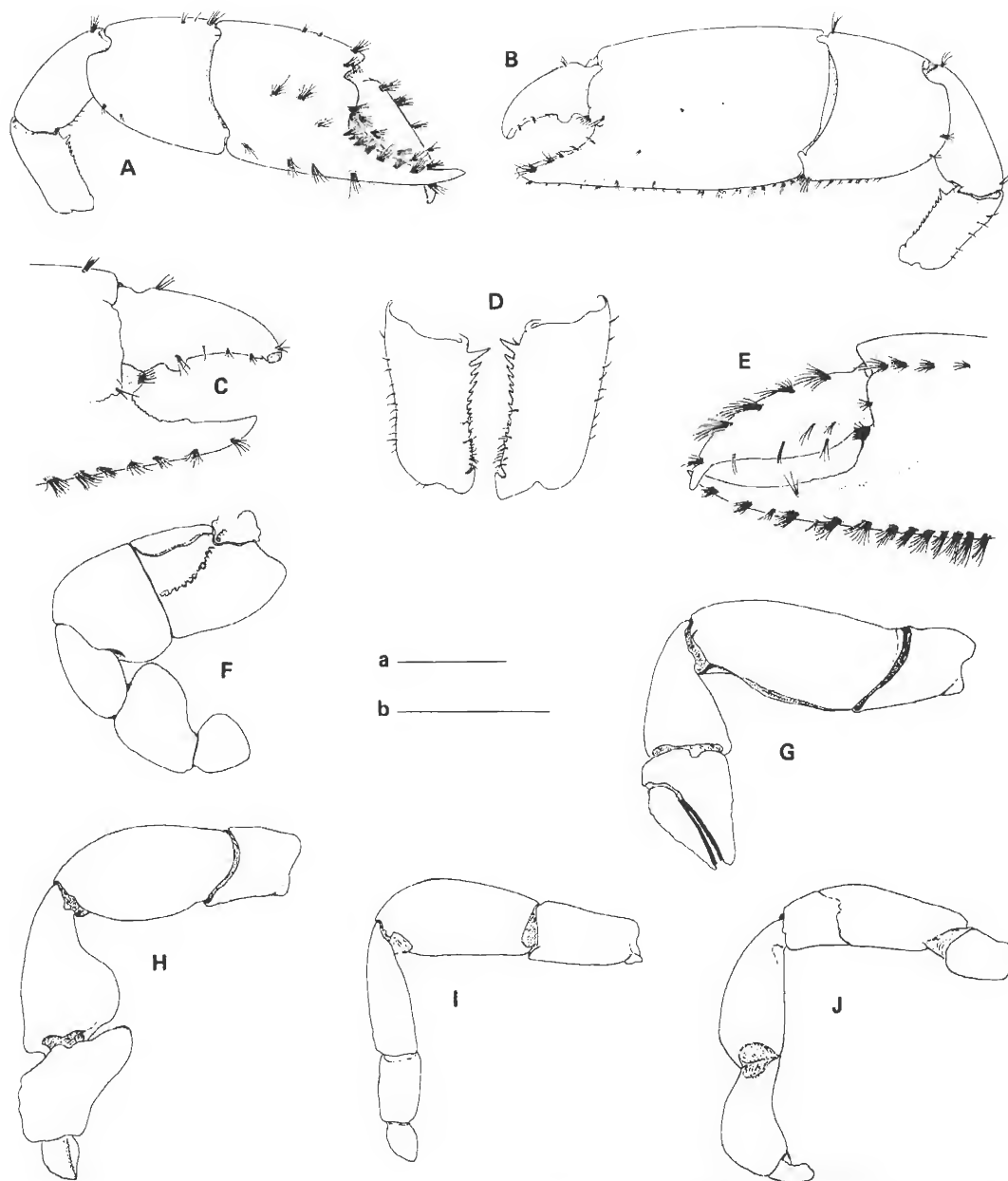


Figure 4. *Calliax jonesi*, n. sp. First pereopods A-E: (A) smaller cheliped, lateral view; (B) larger cheliped, lateral view; (C) larger cheliped, medial view of dactyl and distal part of propodus; (D) ishium of right and left chelipeds; (E) smaller cheliped, medial view of dactyl and distal part of propodus. (F) maxilliped 3, medial view (setae omitted); (G-J) pereopods 2-5, respectively. Scales: a = 4.0 mm (A, B), 2.0 mm (F-J); b = 4.0 mm (C-E).

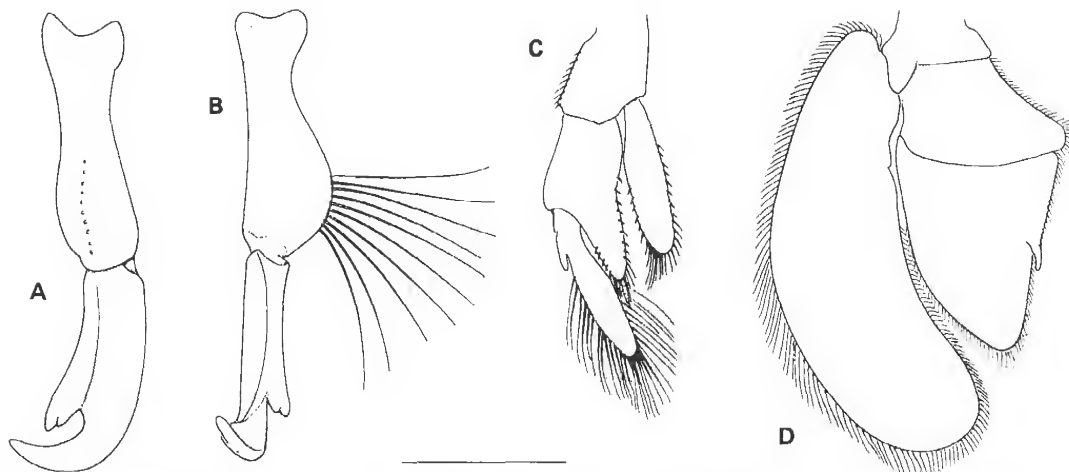


Figure 5. *Calliax jonesi*, n. sp., male pleopods 1-3. (A) right pleopod 1, medial aspect, setae omitted; (B) same, anterior aspect; (C) left pleopod 2, posterior aspect; (D) left pleopod 3, posterior aspect. Scale = 1.0 mm for A, B; 2.0 mm for C, D.

appear to form a closely related species complex. Although they fit de Saint Laurent's (1973) generic diagnosis for *Calliax*, the northwestern Atlantic species differ from the type species by having the first pereopods with typically developed minor chela and the telson with a strongly developed transverse ridge. Except for *C. aequimana*, the western Atlantic species differ from the remaining species of *Calliax* by lacking an exopod on the third maxilliped. It is possible that the Australian species, *C. aequimana*, which also has a strongly developed transverse ridge on the telson, may be more closely related to the currently known species from the western Atlantic than to the Mediterranean and other Pacific species assigned to the genus. *Calliax aequimana* as described by Poore and Griffin (1979) appears to be a highly variable species or possibly a complex of two species.

At this time it is difficult to determine which characters or combinations of characters are of generic or specific importance within the genus *Calliax*. The type species, *C. lobata* is distinguished from all other members of the genus by its "atypically" developed minor first chela. This character, in conjunction with the absence of an exopod on the third maxilliped, the morphology of the telson, and the presence of spines on the merus, distinguishes *C. lobata* from all other species currently assigned to the genus. A detailed morphologic and systematic study of the genus *Calliax* is needed to determine if the genus, as now constituted, represents a single highly variable genus or two or more genera. The characters or combinations of characters that may be of generic importance in re-

viewing the taxonomic status of *Calliax* include the: (1) presence or absence of spines on the merus of the first chelipeds, (2) presence or absence of a transverse ridge on the telson, (3) presence or absence of a podobranch on maxilliped 2, (4) presence or absence of an exopod on maxilliped 3, (5) morphology of the male first pleopod, and (6) armature of the uropods. Other less striking characters such as the spine types found on the mouth parts and maxillipeds may also be of importance.

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A Redescription of *Oncholaimoides elongatus* Hopper, 1961 (Nematoda: Enoplida) with Descriptions of the Other Two Members of the Genus

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A REDESCRIPTION OF *ONCHOLAIMOIDES ELONGATUS* HOPPER, 1961 (NEMATODA: ENOPLIDA) WITH DESCRIPTIONS OF THE OTHER TWO MEMBERS OF THE GENUS

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ABSTRACT *Oncholaimoides elongatus* is redescribed from specimens collected from subtidal, shallow-water sediments from the Gulf of Mexico, Bay County, Florida. The original description of this species was based on a single male specimen from the Gulf of Mexico, Baldwin County, Alabama. Descriptions of *Oncholaimoides rugosus* and *Oncholaimoides striatus* from subtidal sediments of St. Andrew Bay, Bay County, Florida are given. A key to the species of *Oncholaimoides* is provided.

INTRODUCTION

The genus *Oncholaimoides* Chitwood, 1937 was proposed to receive two species of oncholaimoid free-living marine nematodes with a cuticle having transverse striations and longitudinal ridges. The longitudinal ridges are interrupted by the transverse striations. The degree of development of the cuticular striations and ridges was sufficient to differentiate the two species, and Chitwood (1937) gave few measurements and little additional descriptive information for the two species that he placed in the genus. *Oncholaimoides rugosus* Chitwood, 1937 was described from male and female specimens. The cuticle in this species has distinct coarse transverse striations and well-developed longitudinal ridges. *Oncholaimoides striatus* was described from two female specimens. The cuticle has fine transverse striations and much finer longitudinal ridges.

Hopper (1961) described the third species in the genus, *Oncholaimoides elongatus*, from a single male specimen from Gulf of Mexico, Baldwin County, Alabama. This species has a pattern of cuticular ridges similar to that of *O. striatus*. The specimen of *O. elongatus* was differentiated from *O. striatus* on the basis of a larger "a" value, larger amphid, and the presence of a distinct constriction of the tail immediately posterior to the cloaca. Gerlach and Riemann (1974) considered each specific name of the members of the genus as a lapsus and changed the names accordingly (*O. rugosum* to *O. rugosus*, etc.).

Male and female specimens of the three species of *Oncholaimoides* were collected from shallow-water subtidal sediments from the Gulf of Mexico and St. Andrew Bay, Bay County, Florida. The purpose of this paper is to provide a more detailed description of the members of the genus *Oncholaimoides* and provide an amended key to the species.

MATERIALS AND METHODS

Sediment samples were obtained from water 1-5 feet deep (Mean Low Tide) with a 4.5 cm diameter corer to a depth of approximately 10 cm in the sediment. Nematodes were extracted from the sediment samples by repeated washing and decanting. Nematodes were removed alive and fixed in hot 4% formalin in seawater or hot alcohol-formalin-acetic acid for at least 24 hours, cleared in glycerin, and mounted in anhydrous glycerin on Cobb slides. The mean of the measurements is followed by the range in parentheses.

RESULTS

Genus *Oncholaimoides* Chitwood, 1937

Oral opening surrounded by six lips bearing an internal circle of six papillae and an external circle of 10 setae posterior to lips; amphids with elliptical to ovoid openings, moderate to large in size; stoma wide, containing one large (right subventral tooth) and two small teeth (left subventral and dorsal teeth equal). Cuticle transversely striated, bearing longitudinal ridges broken by striae. Male with two short straight spicules. Female with two ovaries; demanian system apparently absent. Caudal glands and spinneret present.

Oncholaimoides elongatus Hopper, 1961

Figures 1-6, 22

Description

Body slender. Cuticle with fine transverse striations beginning just posterior to level of cephalic setae, extending almost to tail tip. Longitudinal striations very

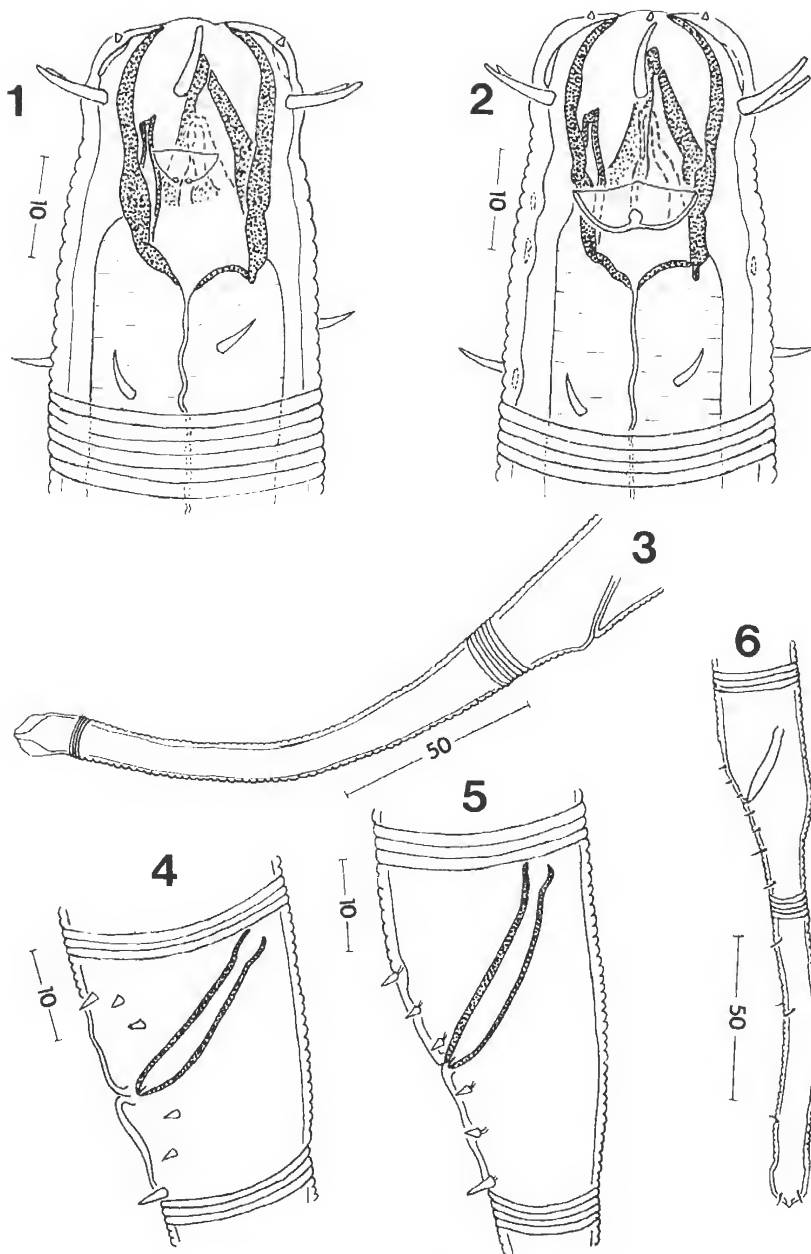


PLATE I

Oncholaimoides elongatus

Figures 1-6. (1) Female, anterior end, lateral view; (2) Male, anterior end, lateral view; (3) Female tail, lateral view; (4) Male specimen 1, left lateral view, cloacal region; (5) Male specimen 2, left lateral view, cloacal region; (6) Male, posterior end, left lateral view.

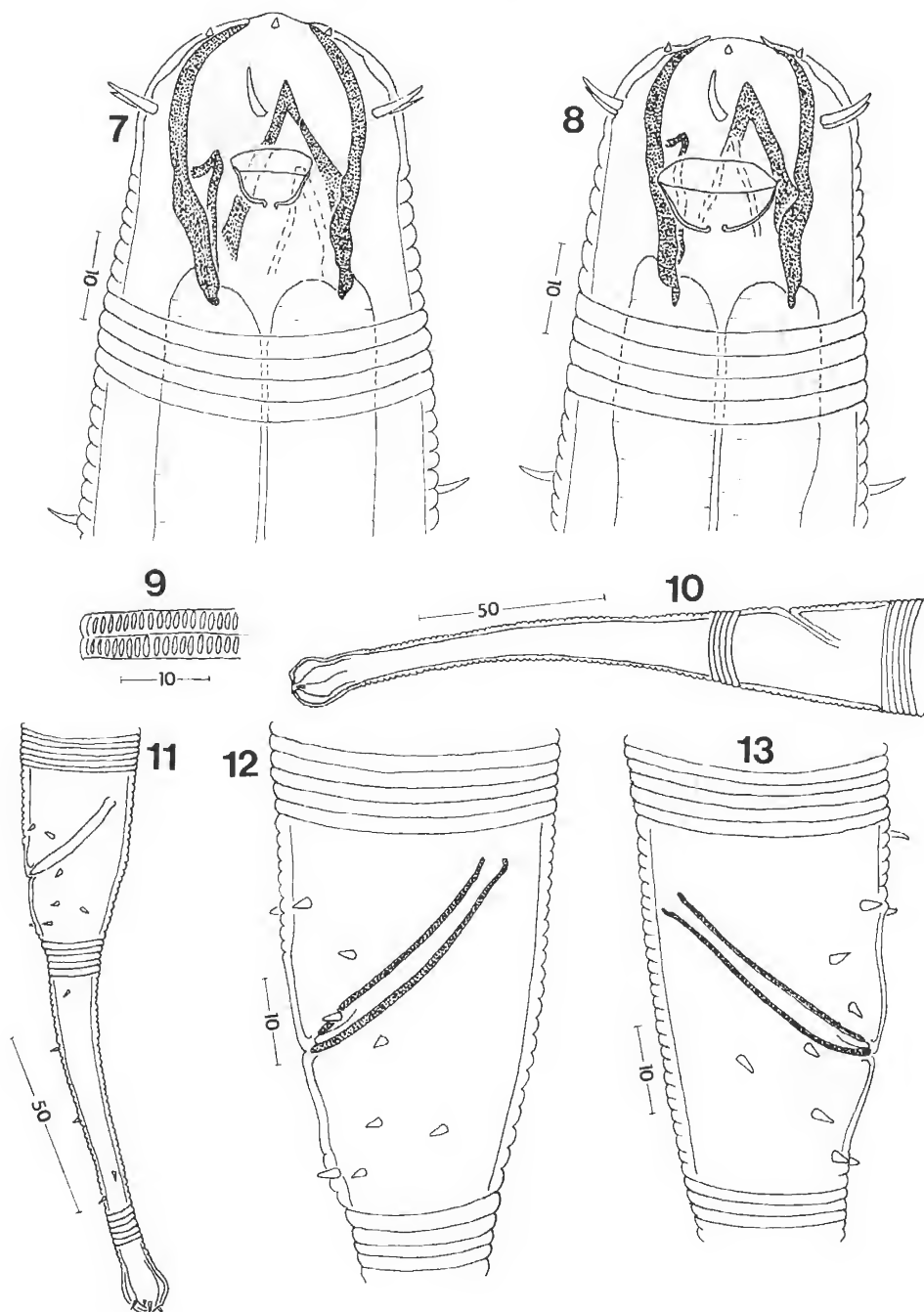


PLATE II

Oncholaimoides striatus

Figures 7-13. (7) Female, anterior end, lateral view; (8) Male, anterior end, lateral view; (9) Cuticular striations and ridges, midbody; (10) Female, tail, lateral view; (11) Male, posterior end, left lateral view; (12) Male specimen 1, left lateral view, cloacal region; (13) Male specimen 2, right lateral view, cloacal region.

fine and difficult to discern; begin about midway between anterior end and nerve ring, and fade at level of anus. Cervical setae present to level of nerve ring, somatic setae not observed, caudal setae present in males, not observed in females. Male amphid aperture posterior to midlevel of buccal cavity, bow-shaped with lateral and posterior margins more heavily cuticularized than anterior margin; width 51.1% (45.8–58.3) of head diameter. Female amphid aperture at midlevel of buccal cavity, lateral and posterior margins not heavily cuticularized; width 31.8% (30.0–33.9) of head diameter. Excretory pore small, posterior to nerve ring; duct very narrow. Male tail abruptly reduced in diameter just posterior to cloaca, then cylindrical. Female tail conical, then cylindrical.

Male ($n = 8$) – Body length 2.32 mm (1.85–2.53); width at midbody 37.6 μm (35.0–45.0). Head diameter 23.0 μm (22.0–24.0) at level of cephalic setae; cephalic setae 8.0 μm (8.0–8.0) and 6.5 μm (6.0–7.0) long. Amphid 12.6 μm (11.0–14.0) wide. Buccal cavity 25.6 μm (24.0–27.0) long, 15.3 μm (14.0–16.0) wide. Esophagus 352 μm (317–382) long; nerve ring 161 μm (142–178), excretory pore 207 μm (176–224) from anterior end. Tail with six pairs short circumcloacal setae; cloacal region slightly depressed. Tail 118 μm (99–131) long; 21.8 μm (19.0–24.0) wide at cloaca. Caudal setae present as subventral pairs, four submedian setae at tail tip. Spicules short, straight, broad, 22.8 μm (21.0–26.0) long; gubernaculum absent. $a = 59.4$ (52.9–68.3); $b = 6.33$ (5.83–6.93); $c = 19.1$ (14.4–23.7).

Female ($n = 4$) – Body length 2.09 mm (1.89–2.31); width at midbody 48.5 μm (42.0–51.0). Head diameter 24.0 μm (22.0–26.0) at level of cephalic setae; cephalic setae 7.5 μm (7.0–8.0) and 6.0 μm (6.0–6.0) long. Amphid 6.5 μm (6.0–7.0) wide. Buccal cavity 26.5 μm (26.0–27.0) long, 16.5 μm (16.0–18.0) wide. Esophagus 349 μm (330–379) long; nerve ring 164 μm (154–179), excretory pore 210 μm (200–221) from anterior end. Tail 150 μm (141–154) long; 21.8 μm (21.0–22.0) wide at anus. Reproductive system amphidelphic; ovaries reflexed; demanian system not observed. Vulva 1.16 mm (1.05–1.29) from anterior end. $a = 43.2$ (40.0–45.3); $b = 5.98$ (5.72–6.16); $c = 14.3$ (12.3–16.4); $V = 55.5\%$ (55–56).

Remarks

The specimens described above as *O. elongatus* differ in some aspects from the original description. One obvious difference is in the length of the buccal cavity. However, examination of the description of the type specimen given by Hopper (1961) revealed a discrepancy between the written description and the figures. The description states that the head diameter is 25 μm and the buccal cavity is 55 μm deep. Examination of figure 10 of the original description reveals that the buccal cavity is about equal in depth to the head

diameter rather than 2.2 times greater. Application of the scale to the drawing confirms that the buccal cavity is about equal to the head diameter or 25 μm deep.

The specimens described above as *O. elongatus* are shorter in body length than the type specimen and the "a" value is smaller. Hopper (1961) reported the "a" value for the type specimen as 97.5 mm. However, the specimens are similar to the description of the type specimen in the presence of a large amphid, fine transverse striations, very fine longitudinal striations, shape and length of spicules, and shape of the tail. The specimens described herein as *O. elongatus* are considered such based upon these similarities. Because the original description was based on a single male, the sexual dimorphism in width and appearance of the amphid that is reported here could not have been determined.

Locality

Fine subtidal sand from water about 1–1.5 m deep, Gulf of Mexico (85°56'54"W and 30°15'00"N).

Specimens

Two males, National Museum of Natural History, USNM 77181, 77182; one female, USNM 77183.

Oncholaimoides striatus Chitwood, 1937

Figures 7–13, 21, 23

Description

Body broad. Cuticle with fine transverse striations and fine longitudinal ridges. Transverse striations begin just posterior to level of cephalic setae. Longitudinal ridges poorly developed anteriorly and posteriorly, best observed in midbody region. Amphid at midlevel of buccal cavity, lateral and posterior margins more cuticularized than anterior margin. Male amphid width 41.6% (38–47) of head diameter; female amphid width 33% (30–38) of head diameter. Cervical setae present to level of nerve ring; somatic setae not observed, caudal setae present in male, not observed in female. Excretory pore small, posterior to nerve ring, duct very narrow. Tail in both sexes conical then cylindrical, tip clavate.

Male ($n = 7$) – Body length 2.13 mm (1.79–2.45); width at midbody 66.0 μm (59.0–70.0). Head diameter 29.7 μm (27.0–32.0) at level cephalic setae; cephalic setae 8.0 μm (7.0–9.0) and 6.0 μm (6.0–6.0) long. Amphid width 12.0 μm (11.0–14.0). Buccal cavity 29.0 μm (27.0–32.0) long; 19.2 μm (18.0–22.0) wide. Esophagus 333 μm (301–370) long; nerve ring 166 μm (154–176), excretory pore 233 μm (224–240) from anterior end. Tail conical with 6–7 pairs circum-

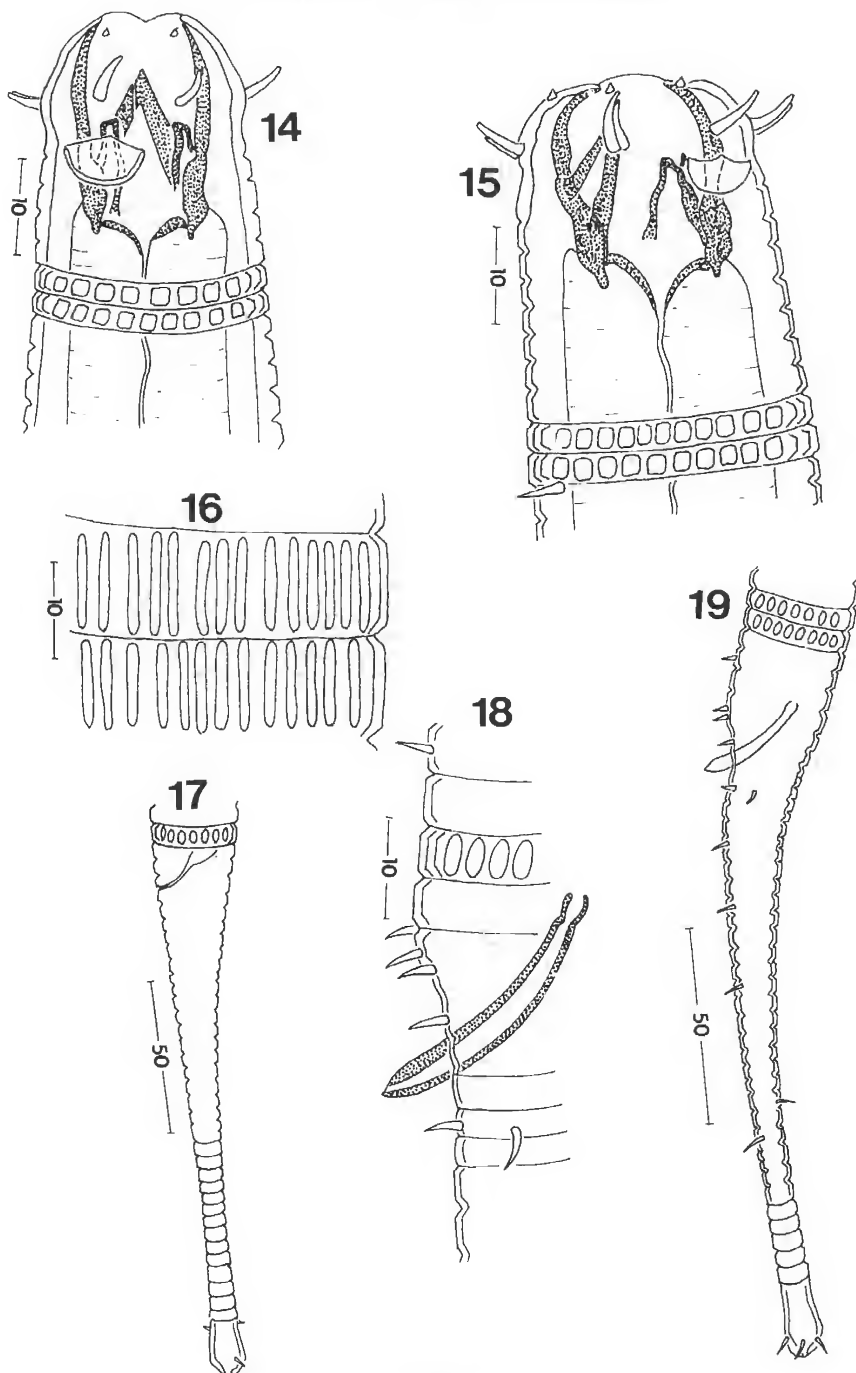


PLATE III

Oncholaimoides rugosus

Figures 14-19. (14) Male, anterior end, lateral view; (15) Female, anterior end, lateral view; (16) Cuticular striations and ridges, midbody; (17) Female, tail, lateral view; (18) Male, left lateral view, cloacal region; (19) Male, posterior end, left lateral view.

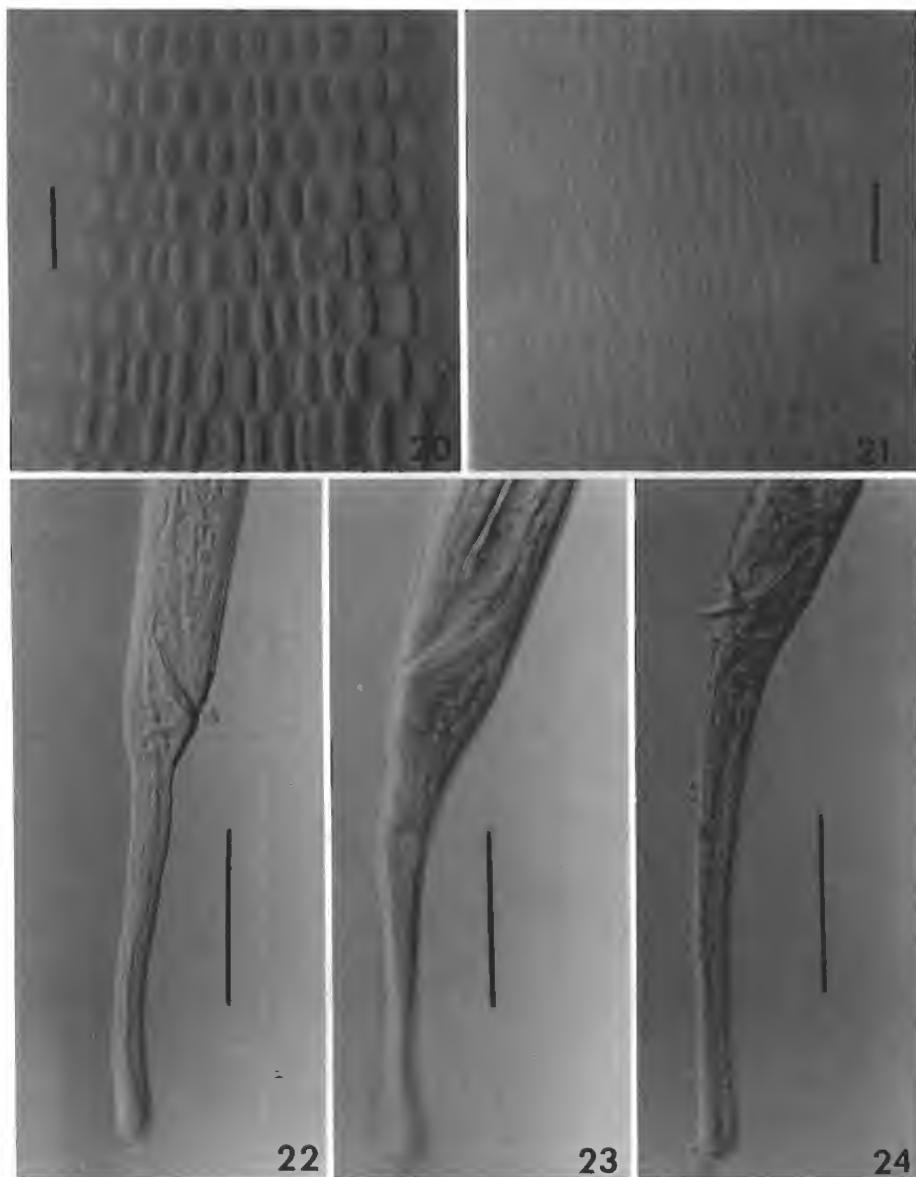


PLATE IV

Figure 20. *O. rugosus*. Cuticular pattern, anterior end. Scale bar = 5 μ m. Figure 21. *O. striatus*. Cuticular pattern, midbody. Scale bar = 5 μ m. Figure 22. *O. elongatus*. Male, posterior end. Scale bar = 40 μ m. Figure 23. *O. striatus*. Male posterior end. Scale bar = 40 μ m. Figure 24. *O. rugosus*. Male posterior end. Scale bar = 40 μ m.

cloacal setae. Tail 140 μm (127–144) long; 26.6 μm (24.0–30.0) wide at cloaca. Caudal setae present as subventral pairs, two subdorsal setae (one long, one short) and single subventral seta on each side at tailtip. Spicules short straight narrow 29.0 μm (26.0–32.0) long; gubernaculum absent. $a = 32.4$ (28.3–41.5); $b = 6.38$ (5.94–6.76); $c = 15.2$ (12.5–17.8).

Female ($n = 5$) – Body length 2.36 mm (2.11–2.53), width at midbody 87.4 μm (74.0–101.0). Head diameter 31.2 μm (28.0–35.0) at level of cephalic setae; cephalic setae 8.0 μm (7.0–9.0) and 6.0 μm (6.0–6.0) long. Amphid width 10.5 μm (10.0–11.0). Buccal cavity 29.5 μm (29.0–30.0) long, 20.0 μm (19.0–22.0) wide. Esophagus 345 μm (320–362) long; nerve ring 174 μm (163–182), excretory pore 225 μm (216–240) from anterior end. Tail 144 μm (128–158) long; 28.4 μm (26.0–32.0) wide at anus. Vulva 1.25 mm (1.06–1.52) from anterior end. Reproductive system amphidelphic; ovaries reflexed; demanian system not observed. $a = 27.7$ (23.0–33.1); $b = 6.85$ (6.66–7.02); $c = 16.5$ (15.5–18.2); $V = 53\%$ (50–60).

Remarks

Chitwood (1937) described *O. striatus* from two female specimens from North Carolina. He described the cuticle of this species as finely striated with minute longitudinal ridges. His drawing of this specimen shows that the longitudinal ridges are distinct in the head region. The specimens described herein have longitudinal ridges apparent from about 1/2 distance from anterior end to the nerve ring to about the level of the anus.

Locality

Several locations from subtidal sediments, both vegetated and nonvegetated in St. Andrew Bay, Bay County, Florida.

Specimens

Three males, USNM 77184, 77185, 77186; two females, USNM 77187, 77188; one juvenile USNM 77189.

Oncholaimoides rugosus Chitwood, 1937

Figures 14–19, 20, 24

Description

Body short, broad. Cuticle with coarse transverse striations and well developed longitudinal ridges. Longitudinal ridges broken into oblong elevated areas of varying lengths over length of body. Transverse striations begin just posterior to cephalic setae. Longitudinal ridges and pattern begin just posterior to buccal

cavity and extend to just anterior to cloaca in male and anus in female, not evident on tail. Amphid at midlevel of buccal cavity. Male amphid with cuticularized walls posteriorly and laterally; cuticularization absent in female amphid. Short cervical setae present to level of nerve ring; somatic setae not observed; caudal setae present. Excretory pore not observed. Tail conical, tip clavate.

Male ($n = 7$) – Body length 1.87 mm (1.65–2.15); width at midbody 61.8 μm (56.0–64.0). Head diameter 21.7 μm (19.0–23.0) at level cephalic setae; cephalic setae 5.0 μm (4.0–6.0) and 4.0 μm (3.0–5.0) long. Amphid width 9.3 μm (8.0–12.0). Buccal cavity 23.0 μm (22.0–25.0) long and 15.4 μm (14.0–18.0) wide. Esophagus 263 μm (256–270) long; nerve ring 146 μm (139–155) from anterior end. Tail 158 μm (149–167) long, 22.4 μm (22.0–24.0) wide at cloaca. Tail with 8–10 pairs circumcloacal setae, caudal setae present; three pairs at tail tip. Spicules short gently curved, 27.4 μm (22.0–29.0) long; gubernaculum absent. $a = 31.4$ (28.0–37.0); $b = 7.08$ (6.30–8.00); $c = 11.8$ (11.1–13.7).

Female ($n = 2$) – Body length 1.84 mm (1.80–1.88); width at midbody 83.0 μm (81.0–85.0). Head diameter 25.5 μm (24.0–27.0) at level cephalic setae; cephalic setae 6.0 μm (6.0–6.0) and 5.0 μm (5.0–5.0) long. Amphid width 6.5 μm (6.0–7.0). Buccal cavity 21.0 μm (20.0–22.0) long, 18.0 μm (18.0–18.0) wide. Esophagus 258 μm (256–259) long; nerve ring 144 μm (139–148) from anterior end. Tail 163 μm (160–166) long, 24.0 μm (24.0–24.0) wide at anus. Caudal setae present near tail tip. Vulva 838 μm (810–865) from anterior end. Reproductive system amphidelphic; ovaries reflexed; demanian system not observed. $a = 22.2$ (21.2–23.2); $b = 7.14$ (6.90–7.34); $c = 11.3$ (11.3–11.3); $V = 45.5\%$ (45.0–46.0).

Remarks

The specimens described herein agree closely with the original description.

Locality

Several locations from nonvegetated sediments in St. Andrew Bay, Bay County, Florida.

Specimens

Two males, USNM 77190, 77191; one female, USNM 77192.

DISCUSSION

Chitwood (1937) separated *O. striatus* from *O. rugosus* on the basis of the varying degree of development of the cuticular striations and ridges. Hopper

(1961) differentiated *O. elongatus* from the closely related *O. striatus* on the basis of the greater body length, greater amphid size, and larger "a" value in *O. elongatus*.

The specimens described herein as *O. elongatus* are similar in body length to *O. striatus*. However, the specimens of *O. elongatus* have a larger "a" value

(1.83 times that of *O. striatus* males and 1.56 times that of *O. striatus* females), more pronounced sexual dimorphism in size and shape of the amphid, spicules are broader, and the male tail has a more definite constriction just posterior to the cloaca as described by Hopper (1961). The following key is based on that given by Hopper (1961).

KEY TO THE SPECIES OF *ONCHOLAIMOIDES*

1. Cuticle with coarse striations and ridges *O. rugosus* Chitwood, 1937
 Cuticle with finer striations and less pronounced longitudinal ridges 2
2. Male amphid not less than 45.8% (mean = 51.1%) of head diameter; "a" value 52.9–97.5. Female "a" value 40.0–45.3 *O. elongatus* Hopper, 1961
 Male amphid not more than 47.0% (mean = 41.6%) of head diameter; "a" value 28.3–41.5. Female "a" value 25.0–37.0 *O. striatus* Chitwood, 1937

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- Hopper, B.E. 1961. Marine nematodes from the coast line of the Gulf of Mexico. *Can. J. Zool.* 39:183–199.

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An Illustrated Key to the Chaetognatha of the Northern Gulf of Mexico with Notes on their Distribution

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Gulf Coast Research Laboratory

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AN ILLUSTRATED KEY TO THE CHAETOGNATHA OF THE NORTHERN GULF OF MEXICO WITH NOTES ON THEIR DISTRIBUTION

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ABSTRACT A key is provided to facilitate the identification of 24 species in nine genera of Chaetognatha occurring in the northern Gulf of Mexico. Included are the deep-water species, *Eukrohnia proboscidea*, *E. calliops*, *Mesosagitta sibogae*, and *Sagitta megalophthalma*, all recent additions to the known fauna of the region. Meristic data, brief descriptions, ecological notes, Gulf of Mexico records, and illustrations are also presented.

INTRODUCTION

Chaetognaths (arrow worms) have long been recognized as a significant trophic link between the vast numbers of marine copepods and larger predators, including many commercially important species of fish (Heydom 1959; Reeve 1966; Nagasawa and Marumo 1981). Certain species are associated with discrete physio-chemical conditions and have, thus, become useful as hydrological indicators in areas of inter-mixing water masses. Some species have gained recognition as vectors in the life cycles of marine parasites (Pearre 1979; Boltovskoy 1981; Jarling and Kapp 1985).

The chaetognath fauna of the Gulf of Mexico is known from various ecological studies concerned with the population structure in continental shelf and open-ocean plankton communities, but few of these works have included detailed descriptions of the animals or dealt with the entire reported fauna of the Gulf. However, descriptions of all species known to occur in the Gulf of Mexico were included in a recent work by Michel (1984) on chaetognaths of the Caribbean Sea and adjacent areas.

The present work, limited in scope to the northern Gulf of Mexico, attempts to facilitate the identification of common species of chaetognaths one might expect to encounter in plankton samples from coastal and offshore waters of the region. The key also includes some rare species recently obtained from deep-water collections.

Prior to 1988, 21 species representing 11 genera were recorded from the Gulf of Mexico. Of those, one is excluded from this key, the monospecific *Bathylaelus typhlops* Owre, a rare, extremely deep-dwelling species known only from a single specimen collected in the central Gulf (Owre 1973). Recently, the deep-water species *Mesosagitta sibogae* Fowler, 1906, *Eukrohnia*

calliops McLelland, 1989, *E. proboscidea* Fumestin and Ducret, 1965, and *Sagitta megalophthalma* Dallot and Ducret, 1969, were added to the Gulf fauna (McLelland and Perry 1989), increasing the number of species to 25. At this writing, the fairly common epibenthic family Spadellidae has yet to be reported in the Gulf of Mexico; thus, only the planktonic species of Chaetognatha are considered in this key.

There are, worldwide, currently about 125 described species of the phylum Chaetognatha belonging to two orders and six families of which the Sagittidae is the most diverse. In his 1965 publication, Tokioka introduced a detailed phylogeny based on morphological similarities in which he arranged the 65 then recognized species into classes, orders, sub-orders, and families and restructured the former genus *Sagitta* into nine genera. Acceptance for Tokioka's proposal, especially the latter point, has been slow to gain support among specialists even though numbers of newly described species continue to mount. Recent systematic works such as those of Kassatkina (1971, 1982), Casanova (1985), and Salvini-Plawen (1986), have expanded upon Tokioka's original proposal. Accordingly, this work conforms to the revised taxonomy of the phylum, including the restructuring of the former genus *Sagitta*, in order to better account for differences among the distinct "groups" within the Sagittidae.

MATERIALS AND METHODS

Chaetognath specimens (from 5-10% buffered formalin samples) were examined unstained under stereoscopic dissecting and compound microscopes. Using an ocular micrometer, total length measurements (excluding the caudal fin) were made and percentages of tail segment to total length (T%) were calculated. Ranges of hooks and teeth recorded in Table 1

TABLE 1
Meristic values of chaetognaths from the northern Gulf of Mexico

Species	Total Length (mm)	% Tail Segment	Number Hooks	Number Anterior Teeth	Number Posterior Teeth	Number Specimens	Source of Specimens
<i>Eukrohnia bathyantartica</i>	16.2	25.6	12	--	12	1	E
<i>E. bathypelagica</i>	5.6-5.9	24.3-25.3	9-10	--	1-5	2	B,E
	7.2-8.8	25.6-27.3	9	--	2-4	4	E
	9.0-10.6	22.6-26.5	8-9	--	2-7	8	E
	11.6-12.6	24.5-29.2	8-10	--	6-12	6	B,E
<i>E. calliops</i>	8.4	26.7	11	--	9-10	1	E
	10.4-11.7	22.3-31.0	11-13	--	7-15	3	E
	12.6-15.0	21.7-29.3	12-13	--	12-13	4	E
	16.2-18.4	24.8-27.0	12-13	--	15-19	4	E
	21.5	24.9	12	--	21	1	E
<i>E. fowleri</i>	5.2-5.3	18.2-24.1	9-10	--	4-5	2	B
	7.0	19.0	12	--	10	1	B
	10.7-11.8	20.0-20.9	10-12	--	6-12	3	E
	13.6-14.4	22.4-24.0	11	--	12	3	E
	26.6-28.5	21.3-23.0	11-13	--	20-27	3	E
<i>E. proboscidea</i>	10.6	24.2	10	--	8	1	E
<i>Krohnita pacifica</i>	3.5-5.0	23.7-31.4	8-10	11-13	--	6	A
	5.3-5.8	29.1-32.1	9	13	--	4	D
	6.4-7.0	28.1-30.0	9	14	--	2	D
<i>K. subtilis</i>	7.6-9.3	31.4-37.8	8	10-11	--	5	A,B
	9.8-10.4	34.7-35.0	7	10	--	2	B,E
	11.2-12.8	31.4-40.1	7-9	10-12	--	11	A,B,E
	13.9-14.2	31.0-40.4	7-8	9-12	--	3	E
<i>Pterosagitta draco</i>	3.7-4.9	37.1-39.5	7	4	6	3	B,D
	5.1-5.9	37.6-41.4	9	6-7	12-14	8	B,D
	6.2-7.2	37.8-41.8	8-10	6-8	13-16	15	B,D
<i>Caecosagitta macrocephala</i>	3.5	39.7	10	3	6	1	B
	5.1-6.5	26.7-37.7	10-12	3-7	8-22	8	B,E
	7.5-10.5	27.7-37.6	10-13	6-10	17-24	11	B,E
	13.2	32.7	12	6	29	1	E
	14.6	33.9	9-11	8	30	1	E
<i>Ferosagitta hispida</i>	6.9-9.4	23.6-28.3	7-8	7-9	10-13	5	A
	11.6-13.9	23.5-27.0	6-8	5-9	10-14	8	D,F
	16.4-16.5	26.8-27.8	7	8-9	12	2	C
<i>Flaccisagitta enflata</i>	6.5-7.9	17.9-18.0	9-11	6	8	2	D
	10.1	17.9	9	7	10	1	F
	14.0-17.2	15.4-18.5	8-9	7-9	10-16	5	D,F
	18.1-19.9	14.9-15.8	8-9	7-11	12-16	4	D,F
<i>F. hexaptera</i>	9.1	22.1	9-10	3	3	1	A
	14.1-17.0	16.4-23.4	7-9	3-4	3-8	4	A,D,E
	20.8-28.3	14.1-22.9	6-9	3-6	1-9	6	A,D,E
	30.6-32.6	16.7-22.0	6-7	2-3	2-6	4	A,D,E
	38.4-44.0	16.7-18.8	6-7	3-4	3-6	3	A,E
	48.8-53.0	18.1-19.3	4-6	4	4-6	2	E
	59.2	16.2	6	4	5	1	E

TABLE 1 (Continued)
Meristic values of chaetognaths from the northern Gulf of Mexico

Species	Total Length (mm)	% Tail Segment	Number Hooks	Number Anterior Teeth	Number Posterior Teeth	Number Specimens	Source of Specimens
<i>F. lyra</i>	12.5-14.3	17.7-20.0	7-9	5-6	6-9	3	A,B
	20.3	15.0	8	6	10	1	E
	22.7-25.7	14.9-17.6	3-9	3-7	2-10	11	A,B,E
	26.0-29.0	13.3-16.0	3-7	6-8	2-10	6	A,B,E
	30.8-34.7	15.0-15.5	3-8	7-8	3-10	3	A,B
<i>Mesosagitta decipiens</i>	8.2-10.1	22.8-32.2	6	7-9	13-17	8	B,E
	11.0-12.6	19.4-26.3	6-7	7-9	14-20	8	B,E
	12.9-13.3	21.2-24.4	6	8-9	19	3	B,E
<i>M. minima</i>	3.8	22.2	7	2	4-5	1	A
	5.0-5.3	16.5-20.5	7-8	3-5	7-12	6	A,D
	6.1-6.8	15.7-19.8	7	3-4	9-11	3	A,D
<i>M. sibogae</i>	10.6-11.8	19.4-27.4	6	8-9	14-17	6	E
	12.4-13.7	17.5-22.9	6	7-9	15-18	7	B,E
	14.0-14.2	20.0-23.6	6	7-9	16-17	3	B,E
	14.8-14.9	21.0-21.9	6	8-9	17	3	B,E
	16.3	21.1	6	9	19-20	1	E
<i>Sagitta bipunctata</i>	4.6	27.3	8	5	9-10	1	A
	8.5-9.6	24.6-26.4	10	5-7	13-17	5	B
	10.0-11.3	24.1-26.0	9-11	6-7	13-15	4	F
	12.3-13.0	25.3-26.4	9-10	5-6	10-15	2	E
<i>S. helenae</i>	6.4	26.5	8	9	7	1	D
	11.3-14.6	23.4-27.6	7-8	11-18	12-14	3	C
	15.5-15.9	21.8-25.4	8	15-19	14-15	4	A,D
	17.2-19.2	23.2-24.3	7	15-16	12	2	D
<i>S. friderici</i>	6.0-7.9	25.0-30.4	7-8	5-8	13-17	22	A,C
	8.1-11.6	25.7-30.2	7-8	6-8	14-19	10	A,C
	12.4-13.7	27.8-29.8	8-9	7-9	17-22	9	A,C
<i>S. megalophthalma</i>	6.8	25.9	7	5	13	1	E
	7.5	24.5	8	6	17	1	E
	10.0	25.6	7-8	8	21	1	E
	11.9-12.1	22.5-28.9	7	7-8	19-21	2	E
<i>S. tenuis</i>	4.8	31.3	8	6	11	1	A
	5.3-5.9	24.6-32.2	7-8	5-6	12-14	8	A,D
	6.0-6.8	25.7-28.6	7-8	5-7	10-16	8	A,D
<i>Serratosagitta serratodentata</i>	5.3-6.4	22.9-28.4	6-8	6-8	10-15	3	A
	6.9-7.9	23.9-26.0	7-8	8-10	16-19	3	F
	8.6-9.7	23.0-24.5	6	9-10	15-20	4	F
	10.0-10.6	25.6-27.2	5-6	9-10	16-20	4	E
<i>Solidosagitta planctonis</i>	8.4	21.0	8-9	5	10-11	1	E
	11.4-11.8	26.1-29.9	10	6-8	14-15	2	E
	16.0-16.4	23.5-24.4	8-9	9-10	17-20	2	E

represent those observed in a single set from either side of the head. The meristic values in the table are based on observations of specimens ranging in size from juvenile to adult from the northern Gulf of Mexico collections listed below. This list is referred to by letter under the "Source of Specimens" column in the table.

- A. U.S. Bureau of Land Management (BLM-SUSIO), 1974; northeastern Gulf of Mexico continental shelf and slope, MAFLA lease tracts (see McLelland 1984); 12 stations, 0–256 m, 54 samples; collected by R.A. Woodmansee, Gulf Coast Research Laboratory (GCRL).
- B. U.S. Dept. of Energy (LBL-OTEC), 1978; Mobile OTEC site (29°N, 088°W), 0–1000 m, 10 samples; collected by J.P. Steen, Jr., GCRL.
- C. NOAA R/V Oregon II, winter cruise, 1975; Mississippi River delta region, surface samples; collected by J.P. Steen, Jr., GCRL.
- D. Louisiana Dept. of Wildlife and Fisheries (LWF), Louisiana Offshore Oil Port Study (LOOP), 1981; over continental shelf south of Timbalier Bay, Louisiana; collected by R. Ganzcak, LWF.
- E. MARFIN Geryon cruises – August and November, 1987 and February, 1988; northern Gulf of Mexico continental slope, 5 sites; 200–677 m; collected by Harriet Perry, GCRL (See McLelland and Perry 1989).
- F. Personal collections of J.A. McLelland from various locations around the Mississippi Sound barrier islands.

Deep-water Collections. The OTEC samples (see B above) were collected during four cruises made between June 15 and October 31, 1978, under Subcontract LBL 4714602, Lawrence Berkeley Laboratory, for the U.S. Department of Energy Contract No. W-7405-ENG-48. Closing plankton nets (0.75 m, 202 μ m mesh) equipped with Niskin double-trip devices were used.

General Morphology

The general features by which most chaetognaths are identified are depicted in Figure 1. Chaetognaths are bilaterally symmetrical enterocoelous coelomates characterized by three body segments – head, trunk, and tail – separated by transverse septae. All chaetognaths display lateral and caudal stabilizing fins, a head armed with chitinous grasping spines (hooks), transparent to semi-opaque bodies, and a lack of excretory and circulatory systems. The nervous system features a primary cerebral ganglion in the head connected to two dorsal eyes, and one large trunk ganglion on the ventral surface. The mouth and anus, both ventral, are connected by a straight digestive tube. As protandric

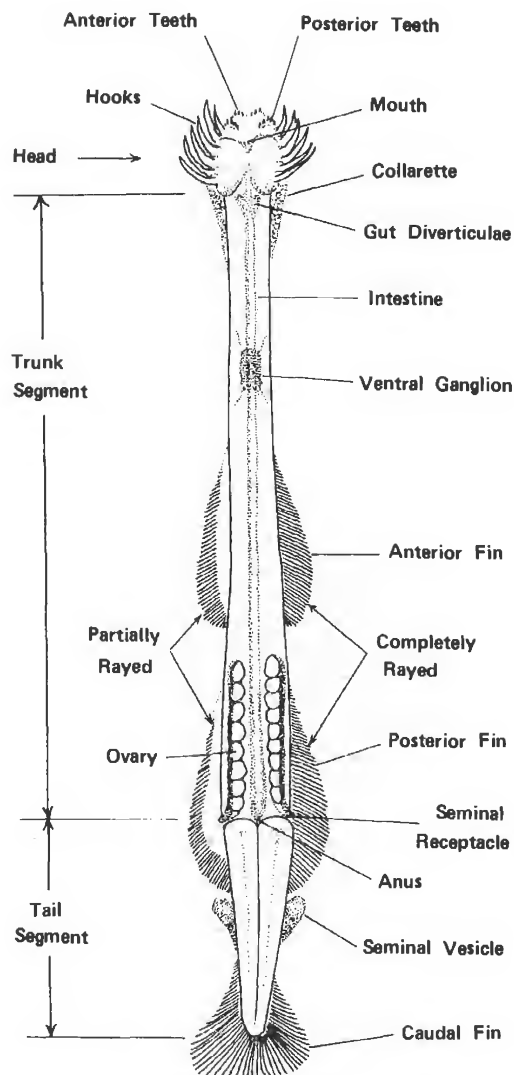


Figure 1. General diagram of a chaetognath showing diagnostic characteristics.

hermaphrodites, chaetognaths feature two oblong ovaries in the trunk segment opening dorso-laterally at the tail-trunk septum and two testes in the tail segment which are connected by minute sperm ducts to exterior seminal vesicles.

This key is primarily intended for the identification of well-preserved adult animals and is based on easily observed external features and some internal features such as mature ovaries. Therefore, caution must be taken when juveniles or sub-adults are examined. It is advisable for one to first become familiar with the

adult forms in a given sample before attempts are made to identify immature specimens. Illustrations for this work were prepared using preserved specimens at hand. Because quality specimens of all species were not available, some whole-animal illustrations were omitted. The reader is referred to Michel (1984) and Alvaríño (1969) for additional illustrations, especially for the genus *Eukrohnia*.

GULF OF MEXICO CHAETOGNATHA species list

Class Sagittoidea Claus and Grobben, 1905

Order Phragmophora Tokioka, 1965

Family Eukrohnidae Tokioka, 1965

Eukrohnia Ritter-Zahony, 1909

E. bathyantarctica David, 1958

E. bathypelagica Alvaríño, 1962

E. calliops McLelland, 1989

E. fowleri Ritter-Zahony, 1909

E. hamata (Möbius, 1875)

E. proboscidea Furnestin and Ducret, 1969

Order Aphragmophora Tokioka, 1965

Family Krohnitidae Tokioka, 1965

Krohnitta Ritter-Zahony, 1910

K. pacifica (Aida, 1897)

K. subtilis (Grassi, 1881)

Family Pterosagittidae Tokioka, 1965

Pterosagitta Costa, 1869

P. draco (Krohn, 1853)

Family Sagittidae Claus and Grobben, 1905

Bathybelos Owre, 1973

B. typhlops Owre, 1973

Caecosagitta Tokioka, 1965

C. macrocephala (Fowler, 1905)

Ferosagitta Kassatkina, 1971

F. hispida (Conant, 1895)

Flaccisagitta Tokioka, 1965

F. enflata (Grassi, 1881)

F. hexaptera (d'Orbigny, 1843)

F. lyra (Krohn, 1853)

Mesosagitta Tokioka, 1965

M. decipiens (Fowler, 1905)

M. minima (Grassi, 1881)

M. sibogae (Fowler, 1906)

Sagitta Quoy and Gaimard, 1827

S. bipunctata Quoy and Gaimard, 1827

S. helenae Ritter-Zahony, 1910

S. friderici Ritter-Zahony, 1911

S. megalophthalma Dallot and Ducret, 1969

S. tenuis Conant, 1896

Serratosagitta Tokioka and Pathansali, 1963

S. serratodentata (Krohn, 1853)

Solidosagitta Tokioka, 1965

S. planctonis (Steinhaus, 1896)

KEY TO THE CHAETOGNATHA OF THE NORTHERN GULF OF MEXICO

1. a. One pair of lateral fins 2
 - b. Two pairs of lateral fins 10
2. a. Lateral fins extending onto trunk segment; one set of teeth 3
 - b. Lateral fins limited to tail segment (Fig. 4); two sets of teeth genus *Pterosagitta* *P. draco*
3. a. Lateral fins extending to ventral ganglion genus *Eukrohnia* 4
 - b. Lateral fins not extending to ventral ganglion genus *Krohnitta* 9
4. a. Eyes with pigment 5
 - b. Eyes without pigment 7
5. a. Apical gland-cell complex bilobate and protruding, causing head to appear pointed (Figs. 2B,E); hook tips bent inward at 45–90° angles (Figs. 2D,G); transverse musculature extending past posterior edge of ventral ganglion 6
 - b. Apical gland not prominent, a single lobed mass (Fig. 3B); hook tips straight (Fig. 3E), transverse musculature even with posterior edge of ganglion *E. fowleri*

6. a. Eye pigment small, elongate or "U" shaped, in posterior region of eye (Fig. 2F) *E. proboscidea*
 b. Eye pigment large, lunate, encompassing most of median portion of eye (Fig. 2C) *E. calliops*
7. a. Number of hooks greater than 11, hook tips straight *E. bathyantartica*
 b. Number of hooks less than 11, hook tips bent inward 8
8. a. Hooks stout, nearly straight; tail less than 25% of body length *E. hamata*
 b. Hooks slender, gently curved; tail usually greater than 25% of body length *E. bathypelagica*
9. a. Outer margin of hooks obtusely angled (Fig. 5G); mature ovaries elongate, may extend past edge of lateral fins (Fig. 5E) *K. pacifica*
 b. Outer margin of hooks evenly rounded (Fig. 5D); mature ovaries compact, not extending past edge of lateral fins (Fig. 5A) *K. subtilis*
10. a. Body flaccid, highly transparent; trunk musculature inconspicuous genus *Flaccisagitta* (Fig. 7) 11
 b. Body rigid, translucent; trunk musculature prominent 13
11. a. Anterior fins long, inserted close to ventral ganglion, connected to posterior fins by raised portion of body cuticle; caudal fin bilobate (Fig. 7D) *F. lyra*
 b. Anterior fin short, rounded, well separated from ventral ganglion and posterior fins; caudal fin not bilobate 12
12. a. Two to four elongate, thin anterior teeth which sometimes protrude anteriorly (Fig. 7C) *F. hexaptera*
 b. Four to eight short, wide, overlapping anterior teeth *F. enflata*
13. a. Hooks finely serrate on inner margins as seen under 100X magnification (Fig. 11B) genus *Serratodentata* *S. serratodentata*
 b. Hooks not serrate 14
14. a. Collarete absent or indistinct 15
 b. Collarete distinct 18
15. a. Eyes without pigment; anterior fins entirely rayed, emerging at a point well separated from ventral ganglion (Fig. 6B) genus *Caecosagitta* *C. macrocephala*
 b. Eyes with pigment; anterior fins with anterior rayless zone, emerging at or near ventral ganglion genus *Mesosagitta* 16
16. a. Tail segment less than 22% of total body length; mature ovaries compact, with three to five large ova (Fig. 8D) *M. minima*
 b. Tail segment usually greater than 22% of total body length; mature ovaries elongate with numerous small ova 17
17. a. Seminal vesicles located approximately equal distance from posterior fins and caudal fin (Fig. 8A); maximum body length at maturity less than 15 mm *M. decipiens*

- b. Seminal vesicles adjacent to caudal fin and well separated from posterior fins (Fig. 8B); maximum body length at maturity may reach 20 mm *M. sibogae*
18. a. Gut diverticulae present* 19
- b. Gut diverticulae absent genus *Sagitta* 20
19. a. Posterior fins triangular with prominent rayless zone; walls of gut tube lined with large vacuolar cells (Fig. 10D) genus *Solidosagitta* *S. planctonis*
- b. Posterior fins rounded, completely rayed; no large vacuolar cells associated with gut tube (Fig. 11E) genus *Ferosagitta* *F. hispida*
20. a. Posterior fins well separated from seminal vesicles 21
- b. Posterior fins contacting the seminal vesicles 22
21. a. Anterior fins emerging posterior to ventral ganglion by a distance of about half the length of the ganglion; large vacuolar cells lining middle third of gut tube (Fig. 10A) *S. megalophthalma*
- b. Anterior fins emerging level with posterior edge of ventral ganglion; no large vacuolar cells associated with gut tube (Fig. 9A) *S. bipunctata*
22. a. Anterior teeth numerous (8–18), elongate, protruding outward in an overlapping, fan-shaped arrangement (Fig. 9D) *S. helenae*
- b. Anterior teeth less numerous (6–9), short, lying flat against head 23
23. a. Mature ovaries with large ova which are few in number and arranged in one row (Fig. 9F) *S. tenuis*
- b. Mature ovaries with small, numerous ova arranged in double rows (Fig. 9H) *S. friderici*

* Gut diverticulae are often undeveloped and thus difficult to see in immature specimens.

EUKROHNIA BATHYANTARCTICA

David, 1958

Diagnosis

Body length at maturity unknown but probably greater than 20 mm. Hooks 11–14. Teeth usually 11–16. T% 19–25. No eye pigment. No collarette. No gut diverticulae. Fins extending from anterior end of ventral ganglion to anterior third of tail segment. Mature ovaries short with small ova. Seminal vesicles ovoid, adjacent to lateral fins. Hooks gently curved with straight tips.

Ecology

Oceanic, bathyplanktonic, probably cosmopolitan. The most deep-living species of the genus in the Gulf of Mexico, occurring at depths to 2800 m (Fagetti 1968). Collected from great depths in the Antarctic and Caribbean Seas (David 1958; Fagetti 1968; Owre 1972,

1973). Listed as meso- to bathyplanktonic (>500–600 m) in the Florida Straits off Miami (Stepien 1980).

Gulf of Mexico records

Open ocean – Fagetti (1968), Owre (1973), McLelland and Perry (1989).

Remarks

One specimen (16.2 mm), an immature individual, was obtained from the bottom net sample (677 m) at Area 5 of the February, 1988 Geryon cruise (Table 1). It was undoubtedly a stray from deeper waters upwelled in the region. It had no denticulate hooks, a feature noted by Owre (1973) for 14 smaller (7.5–12.0 mm) Caribbean specimens. Fagetti (1968) failed to find denticulate hooks on any of her 11 specimens (11.5–20.0 mm) from the Gulf of Mexico and Caribbean Sea.

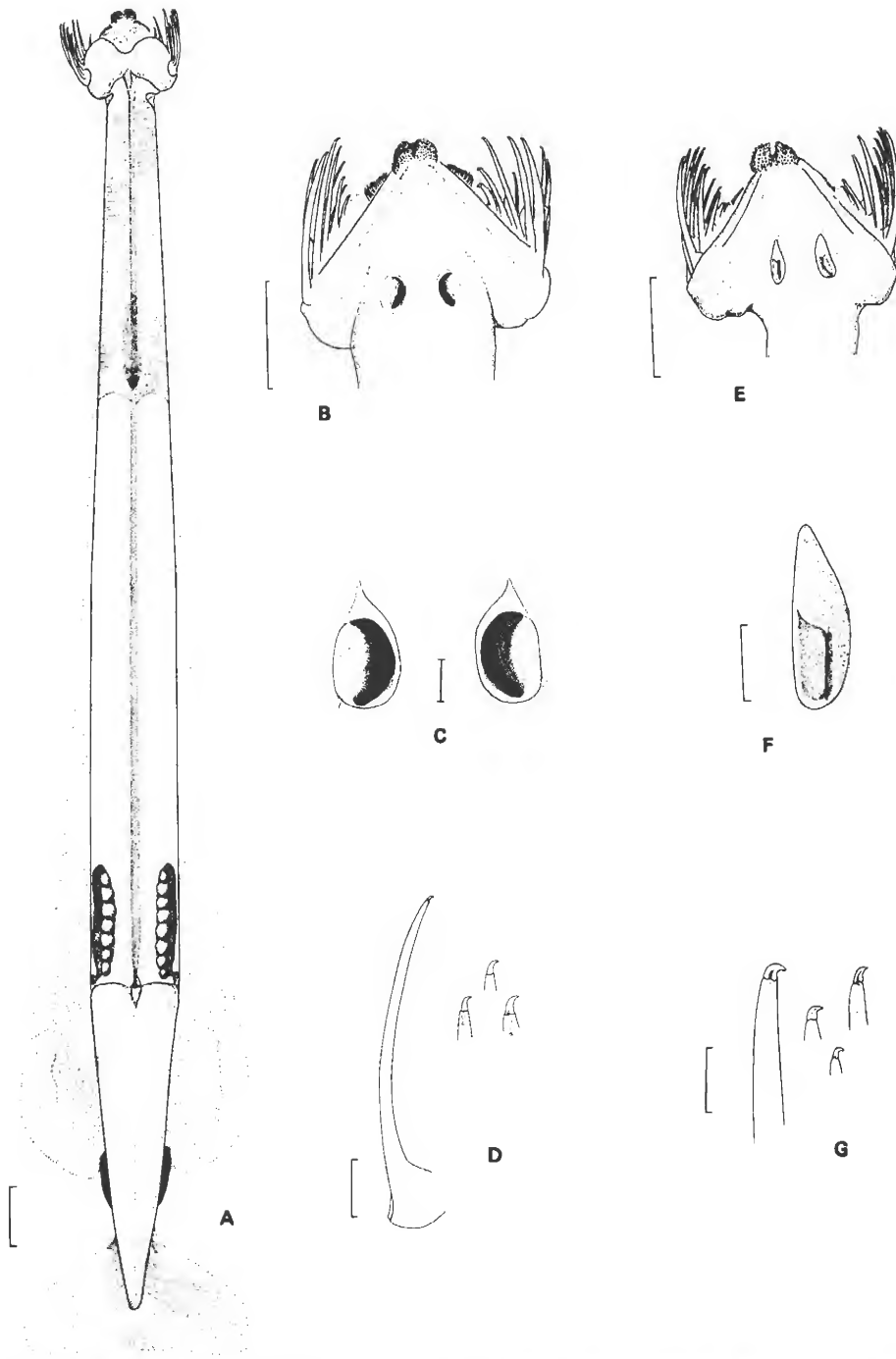


Figure 2. A-D, *Eukrohnia calliops*. E-G, *E. proboscidea*. (A) whole animal, ventral view; (B) head, dorsal view; (C) eyes; (D) hook with tip variations; (E) head, dorsal view; (F) left eye; (G) hook tip variations. Scales: A = 1.0 mm; B, E = 0.5 mm; C, D, F, G = 0.1 mm.

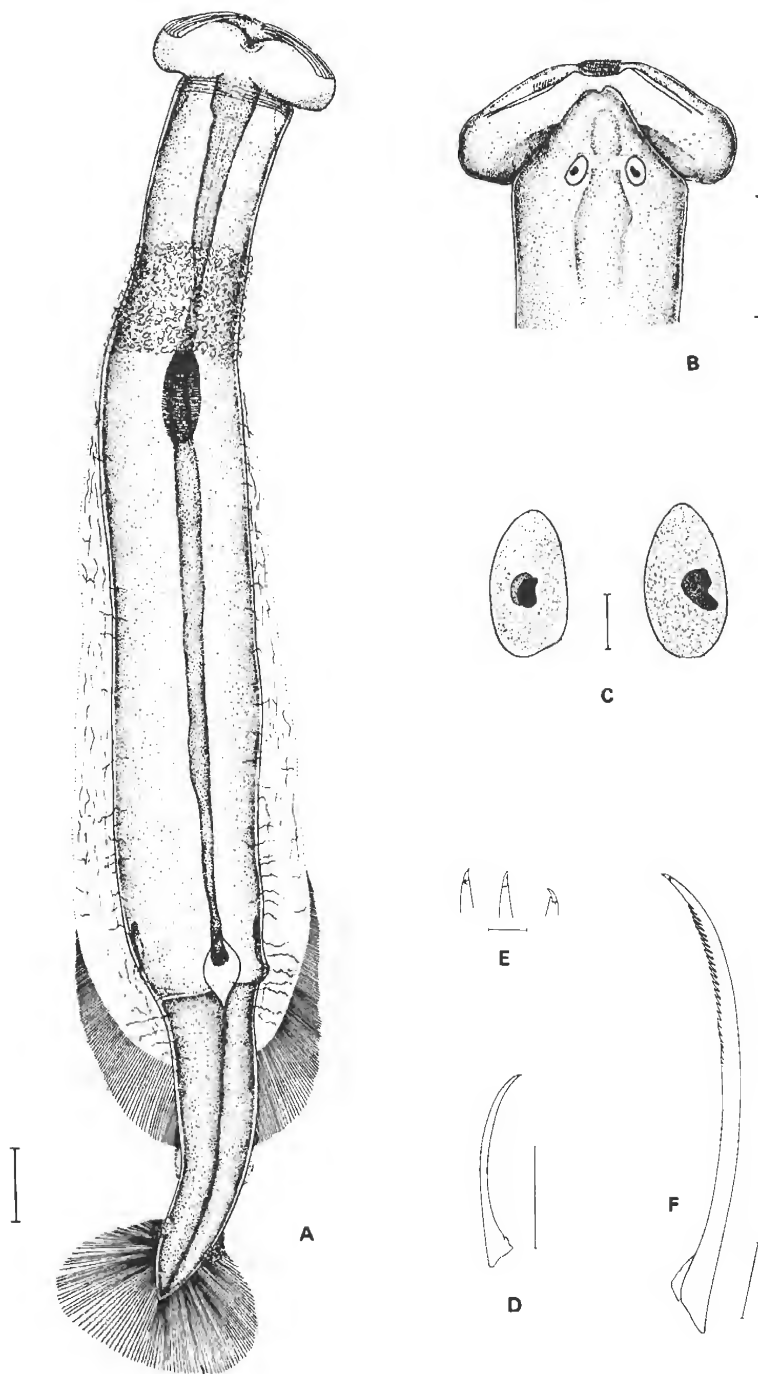


Figure 3. *Eukrohnia fowleri*. (A) immature specimen, ventral view; (B) head, dorsal view; (C) eyes; (D) adult hook; (E) hook tip variations; (F) juvenile hook. Scales: A, B = 1.0 mm; D = 0.5 mm; C, F = 0.1 mm; E = 0.05 mm.

EUKROHNIA BATHYPELAGICA* Alvarifio, 1962*Diagnosis**

Body length at maturity 20–23 mm. Hooks 7–10. Teeth 17–22 (mature). T% 24–29. No eye pigment. No collarette. No gut diverticulae. Lateral fins extending from middle of ventral ganglion to posterior third of tail segment. Ovary tips have coiled appearance before becoming fully mature. Seminal vesicles oval, separated from lateral and caudal fins. Hook tips bent inward at 45–90° angles.

Ecology

Oceanic, meso- to bathyplanktonic, probably cosmopolitan; inhabits cold, deep waters from 200 to 1400 m. Recorded from the North Pacific (Alvarifio 1962) and Atlantic oceans (Ducret 1965; Owre 1973).

Gulf of Mexico records

Open ocean – Owre (1973), McLelland and Perry (1989).

Remarks

Numerous specimens were found in the OTEC (200–800 m) and in the Geryon (200–677 m) samples, but none were mature. They probably were strays from a deeper population offshore. The smallest specimen (5.6 mm) from the OTEC samples did not have denticulate hooks; however, denticulations were present on the two ventral-most pairs of hooks of three specimens (7.2, 7.2, and 7.8 mm) from the Geryon samples. Denticulate hooks have been observed on small specimens of this species by Owre (1973) and Nagasawa and Marumo (1979). All specimens had the characteristic hook tip deflection (an abrupt bend of approximately 45 degrees).

***EUKROHNIA CALLIOPS* McLelland, 1989**
(Figs. 2A–D)

Diagnosis

Body length at maturity 15–22 mm. Hooks 11–13. Teeth up to 21. T% 21–31. Eyes large with dark, lunate pigment cups (Fig. 2C). Paired apical gland at anterior tip of head. Distinct neck. No collarette. No gut diverticulae. Lateral fins broadly rounded at posterior ends, tapering anteriorly, extending from anterior third of ventral ganglion to posterior third of tail segment; fin rays present only in outer-most posterior edge. Caudal fin large, broadly triangular. Mature ovaries short; ova large, round, in two rows. Seminal

vesicles ovoid-elongate, separate from caudal fin, anterior third overlapped by posterior edge of lateral fins. Hook tips sharply deflected inward (Fig. 2D).

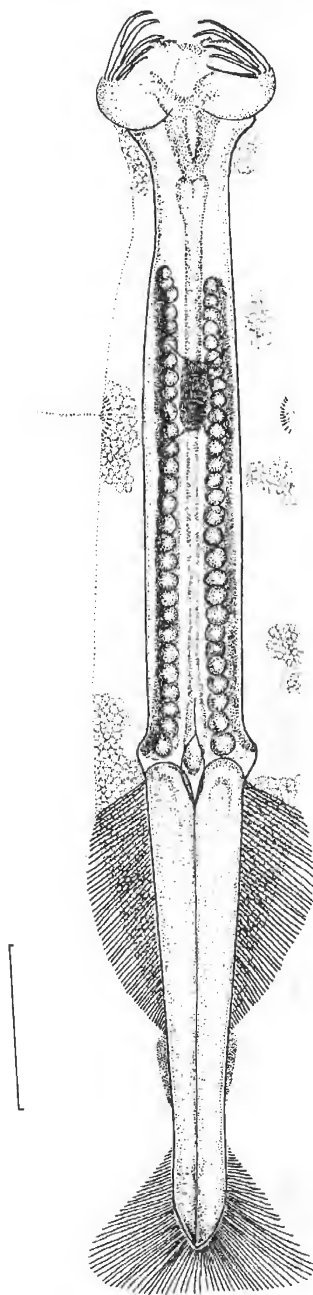


Figure 4. *Pterosagitta draco*. Whole animal, ventral view. Scale = 1.0 mm.

Ecology

Oceanic, mesoplanktonic, probably hypoplanktonic along the continental slope in the northern Gulf of Mexico.

Gulf of Mexico records

McLelland (1989), McLelland and Perry (1989).

Remarks

One hundred and eighty-three (183) specimens were collected at four sites from 200 to 677 m over the Northeast Gulf continental slope in August, 1987, and February, 1988 (MARFIN Geryon cruises). Tokyo Bay (Japan) specimens of a closely related species, *E. kitoui* Kuroda, 1981, on loan from Kazunori Kuroda, were compared to the Gulf of Mexico specimens and found to be substantially different (McLelland 1989). No denticulate hooks were found on any specimens from either species.

***EUKROHNIA FOWLERI* Ritter-Zahony, 1909**
(Figs. 3A-F)

Diagnosis

Body length at maturity 34–40 mm. Hooks 9–13. Teeth up 30. Head wide with conspicuous neck. Eye pigment small, in center of eye (Fig. 3C). In well preserved specimens, thick band of epidermal tissue encircles body at ventral ganglion. Lateral fins with rays only in posterior third. Ovaries short; ova large, few in number, in two rows. Seminal vesicles ovoid, separated from caudal fin. Hooks gently curved with straight tips (Figs. 3D,E), appearing reddish in preserved specimens. Three to four ventral-most pairs of hooks strongly denticulate in small specimens (Fig. 3F).

Ecology

Oceanic, meso- to bathypelagic, cosmopolitan; abundant at depths greater than 600 m (Ducret 1965; Alvarino 1969). Epiplanktonic in polar seas, but submerged to colder waters in tropics (Fraser 1952; Boltovskoy 1981).

Gulf of Mexico records

Open ocean – Every (1968), Fagetti (1968), McLelland (1989), McLelland and Perry (1989).

EUKROHNIA HAMATA* (Möbius, 1875)*Diagnosis**

Body length at maturity 35–43 mm. Hooks 8–9. Teeth up to 25. T% 19–24. No eye pigment. Head small with distinct neck. No collarette. No gut diverticulae. Fins narrow, extending from middle of ventral ganglion to seminal vesicles, with rays only in posterior third. Mature ovaries with small ova arranged in four rows. Seminal vesicles ovoid, adjacent to lateral fins and apart from caudal fin. Tips of hooks bent inward at sharp angle (60–90°).

Ecology

Oceanic, cosmopolitan, epiplanktonic in cold-water regions, submerged to deeper depths toward the tropics (Ducret 1965; Boltovskoy 1981).

Gulf of Mexico records

Open ocean – Pierce (1954).

Remarks

No specimens were found in northern Gulf collections. Pierce's specimens, collected at 495–749 m, were possibly *E. bathypelagica* or *E. bathyantartica*, species unknown at the time of his work.

EUKROHNIA PROBOSCIDEA

Furnestin and Ducret, 1965
(Figs. 2E–G)

Diagnosis

Length at maturity 18–30 mm. Hooks 10–13. Teeth 8–25 (15–25 when mature). T% 20–31. Apical gland bilobate. Eye pigment light brown in color, elongate, situated in posterior region of eye (Fig. 2F). No collarette. No gut diverticulae. Lateral fins extending from posterior edge of ventral ganglion to midpoint of tail segment; rays only in posterior half and outer edge. Mature ovaries short; ova up to 14, in two rows. Mature seminal vesicles ovoid-elongate with anterior third overlapped by lateral fins; well separated from caudal fin. Hook tips bent sharply inward (Fig. 2G).

Ecology

Oceanic, meso- to bathypelagic in tropical and subtropical Atlantic. Type material from 1000 and 1100 m off southwest African coast (Furnestin and Ducret 1965). Four specimens reported from 739 to 2072 m in Caribbean Sea (Owre 1973; Michel et al. 1976).

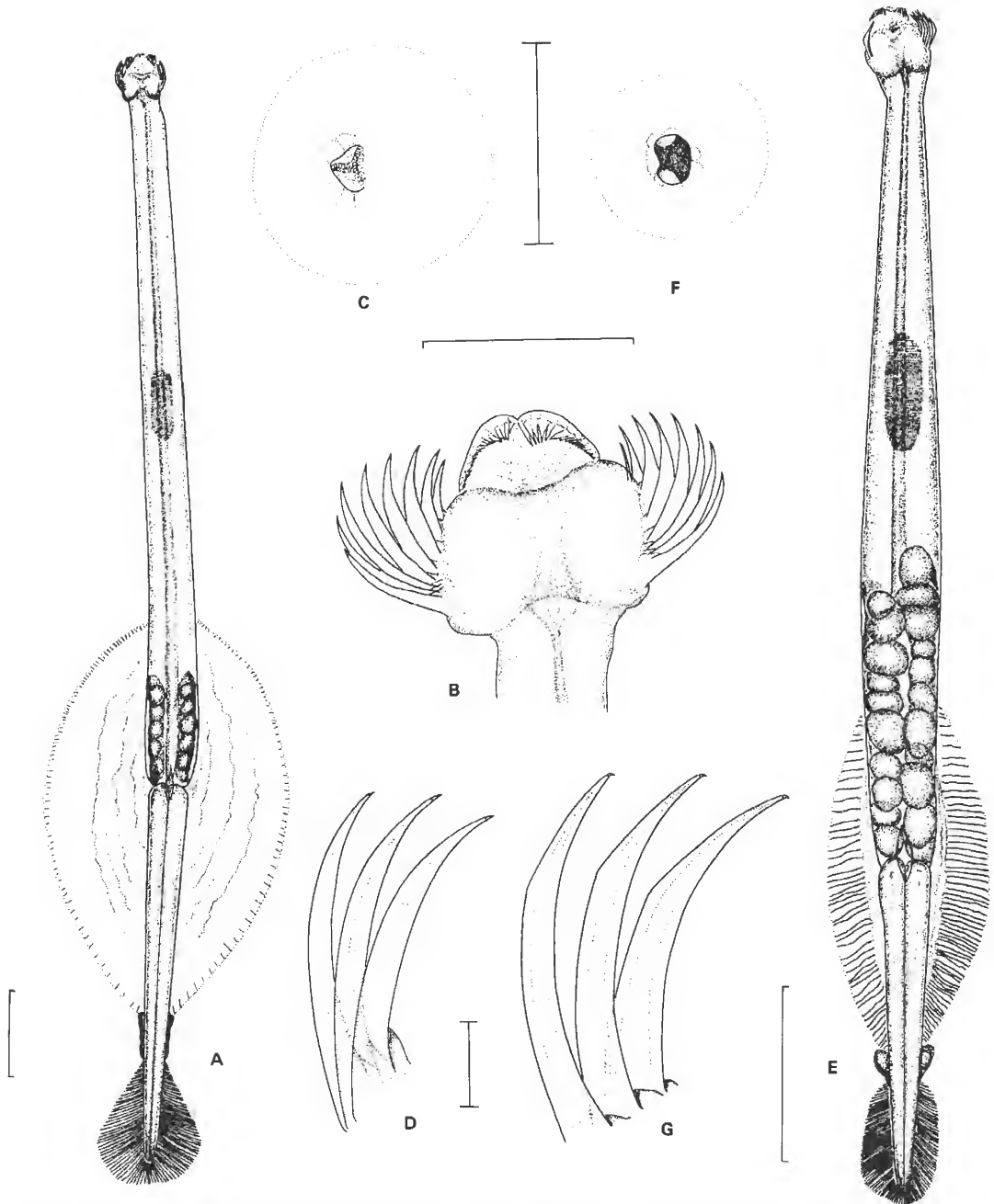


Figure 5. A-D, *Krohnitta subtilis*. E-G, *K. pacifica*. (A) whole animal, ventral view; (B) head, ventral view; (C) right eye; (D) hooks; (E) whole animal, ventral view; (F) right eye; (G) hooks. Scales: A, E = 1.0 mm; B = 0.5 mm; D, G = 0.1 mm; C, F = 0.05 mm.

Gulf of Mexico Records

McLelland (1989), McLelland and Perry (1989).

Remarks

The single specimen collected at Area 5 during the 1988 Geryon cruise constitutes a new record for the Gulf of Mexico (see McLelland 1989). At 10.6 mm, it is the smallest yet recorded for the species. Its position at 29°N, 084°W and depth of 677 m extends the range of the species vertically, northward, and westward where it is considered a stray from a Caribbean population.

***KROHNITTA PACIFICA* (Aida, 1897)**
(Figs. 5E–G)

Diagnosis

Body length seldom longer than 7 mm. Hooks 8–10. Teeth 11–14. T% 23–32. Eye pigment small, round (Fig. 5F). No collarette. No gut diverticulae. Lateral fins extending from seminal vesicles to a point midway between ventral ganglion and trunk-tail septum; gently curved, narrow, with rayless zone comprising about half of fin area. Caudal fin spatulate, often continuous with lateral fins. Mature ovaries long, may reach ventral ganglion; ova round or cuboidal, in one row. Seminal vesicles small, oval, usually overlapped by lateral and caudal fins. Hooks flat, highly transparent, light brown in color, outer edges obtusely angled (Fig. 5G).

Ecology

Semi-neritic, epipelagic, cosmopolitan in tropical and subtropical seas (Fumestini 1966; Boltovskoy 1981). Often associated with outer coastal regions of mixed water (Pierce and Wass 1962; Almeida-Prado 1968; McLelland 1978, 1984).

Gulf of Mexico records

Coastal – Cuba: Suárez-Caastro (1955). Florida: Ritter-Zahony (1910), Pierce (1951), Smith (1955). Northeast Gulf: Mulkana and McIlwain (1973), McLelland (1978, 1984). Texas: Pierce (1962), Adelman (1967). Mexico: Vega-Rodriguez (1964, 1965), Mostajo (1978).

Open ocean – Kolesnikov (1966), Alvarado (1969 – as *K. mutabii*), Michel et al. (1976).

Remarks

According to Owre (1960), Ritter-Zahony's (1910) specimens of *K. subtilis* were probably *K. pacifica*. Owre (1973) considers *K. mutabii* Alvarado, 1969 to be a synonym of *K. pacifica*.

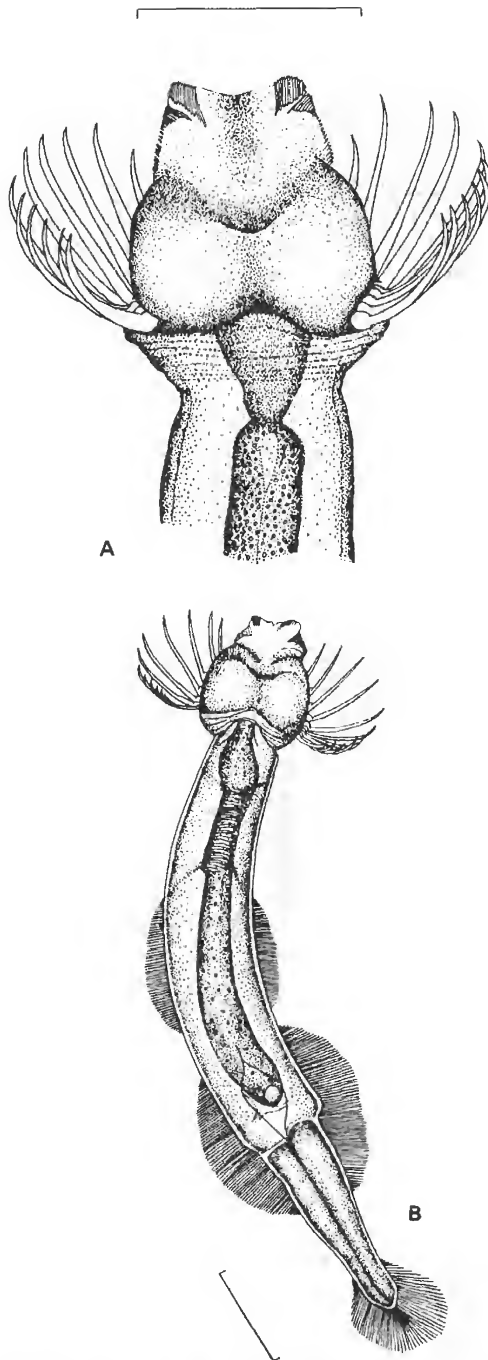


Figure 6. *Caecosagitta macrocephala*. (A) head, ventral view; (B) immature specimen, ventral view. Scales: = 1.0 mm.

KROHNITTA SUBTILIS (Grassi, 1881)
(Figs. 5A-D)

Diagnosis

Body length at maturity 12–16 mm. Hooks 7–9. Teeth 9–12. T% 31–40. Eye pigment small, three-pointed (Fig. 5C). No collarette. No gut diverticulae. Fins semi-circular, delicate, almost totally rayless, extending from seminal vesicles to 2/3 distance from septum to ventral ganglion. Ovaries short, not extending past edge of lateral fins; ova round or oval, in two rows. Seminal vesicles small, rounded, touching lateral and caudal fins. Hooks clear, highly transparent, cutlass shaped (Fig. 5D).

Ecology

Oceanic, lower epipelagic to mesoplanktonic, cosmopolitan in tropical to temperate waters (Alvarinho 1965; Boltovskoy 1981). Usually reported as mesoplanktonic (200–400 m) in tropical and subtropical seas (Furnestin 1957; Owre 1960; Matlin 1974). Not common in near-shore coastal waters.

Gulf of Mexico records

Coastal – Cuba: Suárez-Caabro (1955). Florida: Maidana and Mostajo (1980). Northeast Gulf: McLelland (1978, 1984). McLelland and Perry (1989). Texas: Pierce (1962). Mexico: Vega-Rodriguez (1964, 1965), Mostajo (1978).

Open ocean – Pierce (1954), Kolesnikov (1966), Kolesnikov and Alfonso (1966), Every (1968), Fagetti (1968).

Remarks

This species reaches a greater length at maturity than *K. pacifica* and is narrower, more transparent, and inhabits deeper strata.

PTEROSAGITTA DRACO Krohn, 1853
(Figs. 4, 12H)

Diagnosis

Mature body length 7–10 mm. Hooks 7–10. Anterior teeth up to 8. Posterior teeth up to 16. T% 37–42. Eye pigment small, elongate (Fig. 12H). Voluminous collarette extending onto tail segment, becoming continuous with lateral fins, possessing lateral tufts or bristles (seen on well preserved specimens). Gut diverticulae present. Tail segment constituting almost half of body length. Lateral fins entirely rayed, confined to tail segment. Ova large, in two rows; mature ovaries may extend full length of trunk cavity. Seminal vesicles

elongate, contacting lateral fins and lying close to caudal fin.

Ecology

Oceanic, epipelagic, cosmopolitan in tropical and subtropical areas (Owre 1960; Alvarinho 1965). Apparently tolerates mixed water along continental shelf regions (Pierce 1962; Pierce and Wass 1962; Saint-Bon 1963; McLelland 1984).

Gulf of Mexico records

Coastal – Cuba: Suárez-Caabro (1955). Florida: Alvarinho (1969), Maidana and Mostajo (1980). Northeast Gulf: Alvarinho (1969), McLelland (1978, 1984), McLelland and Perry (1989). Texas: Pierce (1962). Mexico: Vega-Rodriguez (1964, 1965).

Open ocean – Central Gulf: Pierce (1954), Kolesnikov (1966), Kolesnikov and Alfonso (1966), Every (1968), Alvarinho (1969), Owre (1973), Michel et al. (1976), Mostajo (1978).

CAECOSAGITTA MACROCEPHALA (Fowler, 1905)
(Figs. 6A,B)

Diagnosis

Body firm, opaque, with conspicuously large head. Body length at maturity 20–22 mm. Hooks 10–13, reddish in color. Anterior teeth 3–10. Posterior teeth up to 30. T% 26–40. No eye pigment. No collarette. No gut diverticulae. Anterior fins short, completely rayed, separated from ventral ganglion by about half their length. Posterior fins longer and wider than anterior fins, with small rayless zone at anterior end; length equally divided over trunk and tail segment. Seminal vesicles oval, separated from posterior and caudal fins. Ovaries may reach ventral ganglion when mature, containing small ova in multiple rows.

Ecology

Oceanic, cosmopolitan, meso- to bathypelagic in all oceans (Alvarinho 1965; Boltovskoy 1981).

Gulf of Mexico records

Coastal – Northeast Gulf: McLelland and Perry (1989).

Open ocean (as *Sagitta macrocephala*) – Pierce (1954), Every (1968), Fagetti (1968), Owre (1973), Michel et al. (1976).

Remarks

Most specimens have dark granular material in the

wall of the gut which may be red or orange pigmented in fresh specimens (Alvaríño 1967). Several specimens, all immature, were examined from the OTEC (200–1000 m) and Geryon (200–677 m) samples.

***FEROSAGITTA HISPIDA* (Conant, 1895)**
(Figs. 11E, 12G)

Diagnosis

Body length at maturity 8–12 mm. Hooks 6–8. Anterior teeth 5–9. Posterior teeth 10–14. T% 23–28. Head large, conspicuous. Eye pigment square to bean-shaped (Fig. 12G). Collar extending 1/2 to 2/3 distance from neck to ventral ganglion. Gut diverticulae present. Lateral fins entirely rayed; anterior fins emerging at posterior edge of ventral ganglion; posterior fins extending to seminal vesicles. Mature ovaries may extend past midpoint of anterior fin; ova round, in two rows. Ripe seminal vesicles large, oval to rectangular, separated from caudal fin by half their length.

Ecology

Neritic, epipelagic, in inshore tropical-subtropical Atlantic waters (Alvaríño 1965; Reeve 1966). Indicates presence of inshore water when collected offshore (Owre 1960; Pierce and Wass 1962; Ducret 1968; Michel et al. 1976).

Gulf of Mexico records (*As Sagitta hispida*)

Coastal – Cuba: Suárez-Caabro (1955). Florida: Pierce (1951), Smith (1955), Hopkins (1966), Kelly and Dragovich (1968), Maidana and Mostajo (1980). Northeast Gulf: Mulkana and McIlwain (1973), McLelland (1978, 1984). Texas: Pierce (1962), Adelmann (1967). Mexico: Vega-Rodríguez (1964, 1965), Suárez-Caabro and Gomez-Aguirre (1965), Mostajo (1978).

Open ocean – Kolesnikov (1966), Every (1968), Alvaríño (1969).

Remarks

The genus *Ferosagitta* Kassatkina, 1971 was created to separate the similar species *F. ferox*, *F. hispida*, and *F. robusta* from the former genus *Parasagitta* Tokioka, 1965 (See Kassatkina 1982).

***FLACCISAGITTA ENFLATA* (Grassi, 1881)**
(Figs. 7A, 12B)

Diagnosis

Body length at maturity 18–25 mm. Hooks 8–11.

Anterior teeth 6–11. Posterior teeth up to 16. T% 14–18. Eye pigment star-shaped (Fig. 12B). No collar. No gut diverticulae. Anterior fins short, narrow, well separated from ventral ganglion, rayed only on outer posterior edges. Posterior fins large, rounded, 2/3 length on trunk, rayed only on outer posterior edges. Mature ovaries may reach anterior fins; ova rounded, varying in size, in 2–3 rows. Seminal vesicles small, rounded, contacting caudal fin. Mature testes with conspicuously compacted "V" shaped cluster of material at posterior end of tail segment.

Ecology

Oceanic and semi-neritic, cosmopolitan, epipelagic in tropical and temperate regions (Pierce 1951, 1953; Alvaríño 1965; Boltovskoy 1981). Little tolerance for low salinities or persistently high temperature (Pierce 1951).

Gulf of Mexico records (*As Sagitta enflata*)

Coastal – Cuba: Suárez-Caabro (1955). Florida: Pierce (1951), Smith (1955), Hopkins (1966), Kelly and Dragovich (1968), Alvaríño (1969), Maidana and Mostajo (1980). Northeast Gulf: Alvaríño (1969), Mulkana and McIlwain (1973), Perry and Christmas (1973), Show (1973), McLelland (1978, 1984). Texas: Pierce (1962), Adelmann (1967). Mexico: Vega-Rodríguez (1964, 1965), Suárez-Caabro and Gomez-Aguirre (1965), Mostajo (1978).

Open ocean – Pierce (1954), Kolesnikov (1966), Kolesnikov and Alfonso (1966), Every (1968), Alvaríño (1969) Michel et al. (1976).

Remarks

This species is the most commonly reported and easily recognized chaetognath in tropical and subtropical waters.

***FLACCISAGITTA HEXAPTERA* (d'Orbigny, 1843)**
(Figs. 7B,C, 12A)

Diagnosis

Body length at maturity 38–40 mm. Hooks 6–10. Anterior teeth 2–6 (usually 2–4). Posterior teeth 3–8 (usually 3–5). T% 17–20. Eye pigment elongate, T-shaped (Fig. 12A). No collar. No gut diverticulae. Anterior fins short, rounded, well separated from ventral ganglion; rays only on outer edge. Posterior fins large, rounded, 2/3 length on trunk, with internal, anterior rayless zone. Mature ovaries reach ventral ganglion; ova small, in three rows. Seminal vesicles small, rounded, close to caudal fin.

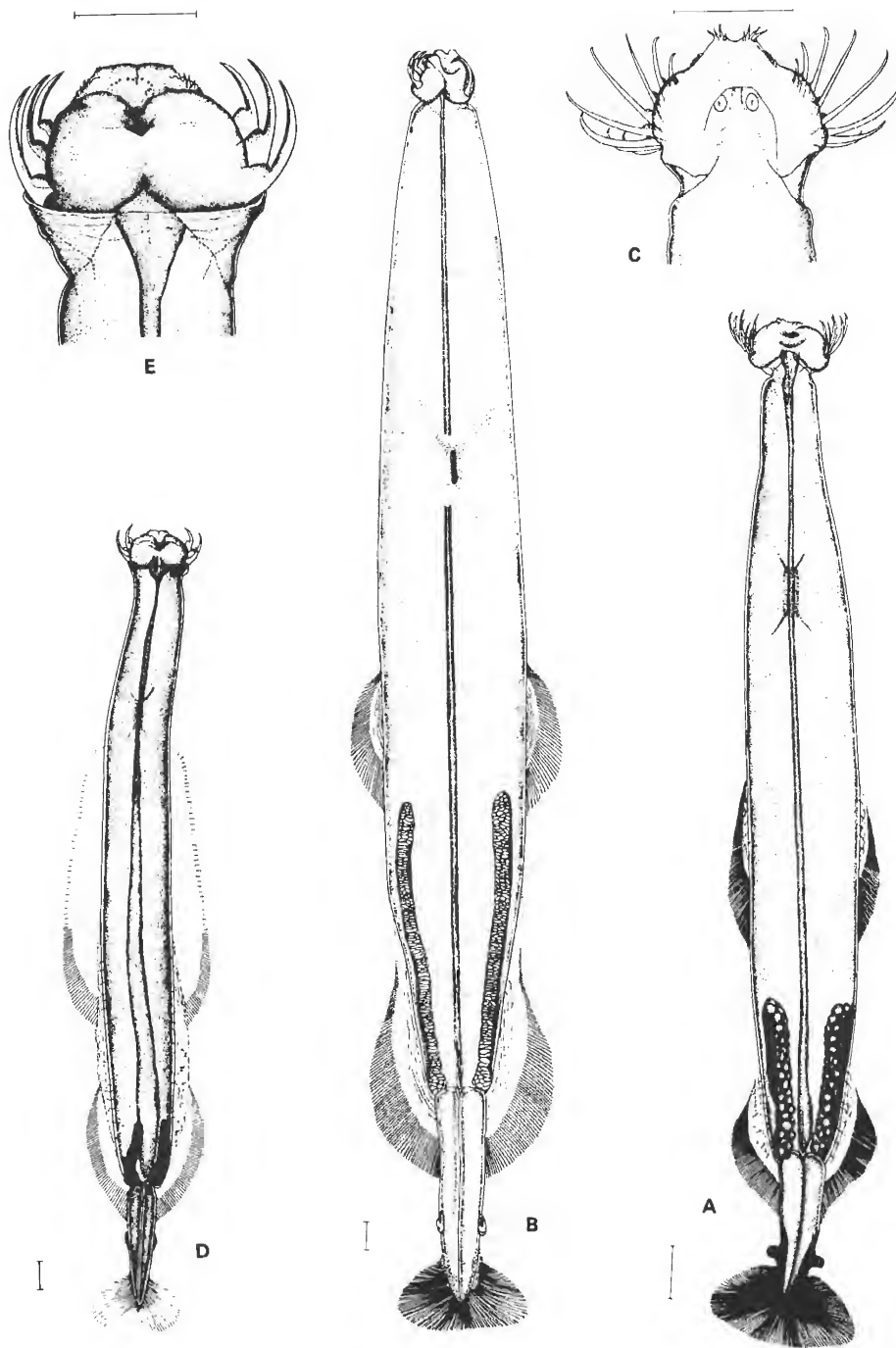


Figure 7. A, *Flaccisagitta enflata*. B, C, *F. hexaptera*. D, E, *F. lyra*. (A,B,D) whole animals, ventral views; (C) head, dorsal view; (E) head, ventral view. Scales = 1.0 mm.

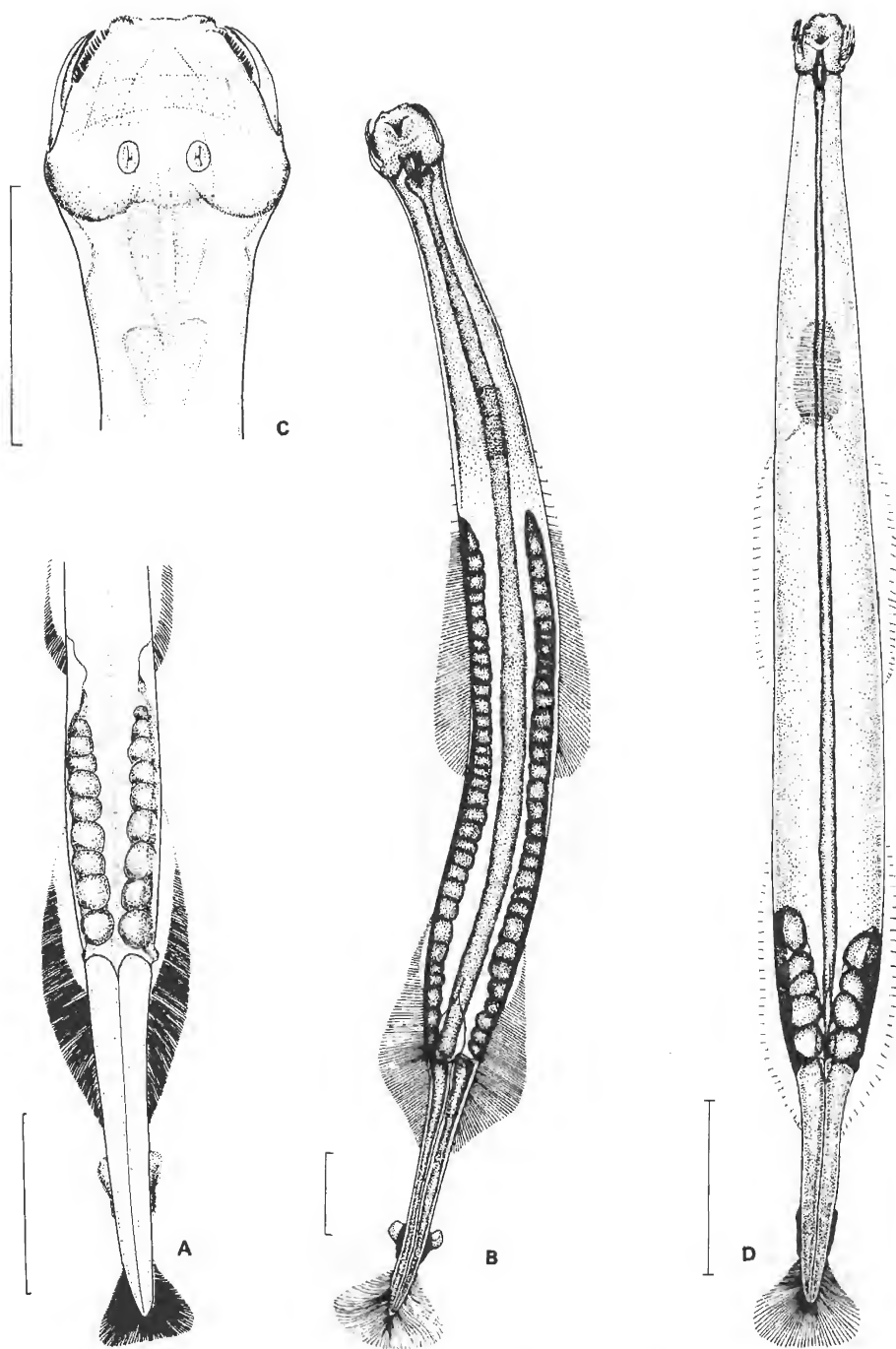


Figure 8. A, *Mesosagitta decipiens*. B, C, *M. sibogae*. D, *M. minima*. (A) posterior end of body, ventral view; (B, D) whole animal, ventral view; (C) head, dorsal view. Scales = 1.0 mm.

Ecology

Oceanic, cosmopolitan, epipelagic in tropical and temperate regions (Alvario 1965). Associated with deeper epipelagic zones (100–500 m) in warm seas (Owre 1960; David 1963; Mattlin 1974). Seldom occurs in shallow coastal waters.

Gulf of Mexico records (As Sagitta hexaptera)

Coastal – Cuba: Suárez-Caastro (1955). Florida: Alvario (1969), Maidana and Mostajo (1980). Northeast Gulf: Alvario (1969), Mulkana and McIlwain (1973), McLelland (1978, 1984), McLelland and Perry (1989 – as *F. hexaptera*). Mexico: Vega-Rodriguez (1964, 1965), Mostajo (1978).

Open ocean – Pierce (1954), Kolesnikov (1966), Kolesnikov and Alfonso (1966), Every (1968), Alvario (1969), Owre (1973), Michel et al. (1976).

Remarks

This species resembles *F. enflata* but is usually associated with higher salinity and deeper water. One of the largest chaetognaths, it may reach 70 mm in cold waters (Alvario 1967). Because of its large size, it has been implicated as a predator of larval fish (Alvario 1980, Thuesen and Bieri 1987).

FLACCISAGITTA LYRA (Krohn, 1853)
(Figs. 7D,E; 12C)

Diagnosis

Body length at maturity 30–38 mm. Hooks 3–9. Anterior teeth 3–8. Posterior teeth up to 10. T% 15–20. Eye pigment elongate, Y-shaped (Fig. 12C). No collarette. No gut diverticulae. Anterior fins emerge near the posterior edge of the ventral ganglion, anterior 2/3 of length rayless. Posterior fins triangular, with large laminate rayless zone. Lateral fins connected by raised portion of body cuticle, or "fin bridge". Caudal fin bilobate on posterior edge. Ovaries long; ova small, in four rows. Seminal vesicles small, oval, situated close to posterior fins. Hooks robust, transparent, with conspicuous flange at base.

Ecology

Oceanic cosmopolitan in tropical and temperate regions (Alvario 1965). Epipelagic to mesopelagic (100–700 m) in open ocean waters (Pierce 1954; Owre 1960; David 1963).

Gulf of Mexico records (As Sagitta lyra)

Coastal – Texas: Pierce (1962). Northeast Gulf:

McLelland (1978, 1984), McLelland and Perry (1989 – as *F. lyra*).

Open ocean – Pierce (1954), Kolesnikov and Alfonso (1966), Every (1968), Owre (1973), Michel et al. (1976).

Remarks

As they mature, these animals tend to lose hooks and teeth. Fully mature specimens usually possess 3 hooks (Fig. 7E), 3–5 anterior teeth, and 2–4 posterior teeth.

MESOSAGITTA DECIPIENS (Fowler, 1905)
(Figs. 8A, 12E)

Diagnosis

Body length at maturity 10–14 mm. Hooks 6–7. Anterior teeth 7–9. T% 19–32. Posterior teeth 13–20. Eye pigment elongate, T-shaped (Fig. 12E). No collarette. Gut diverticulae prominent. Anterior fins tapered, emerging level with posterior edge of ventral ganglion, with small rayless zone at anterior end. Posterior fins rounded, equally situated over trunk and tail segments, widest near posterior end, with small rayless zone at anterior end. Mature ovaries with large ova in one row, extending to anterior fins; anterior end of ovaries produced into a sharp point which continues as a fine fiber connected to the body wall (Fig. 8A). Seminal vesicles long and narrow, equidistant from posterior and caudal fins.

Ecology

Oceanic, cosmopolitan in tropical to temperate regions, lower epipelagic to deep mesopelagic (David 1963; Alvario 1965; Fagetti 1972; Pierrot-Bults 1979). Associated with low levels of illumination and temperature (Owre 1960).

Gulf of Mexico records (As Sagitta decipiens)

Coastal – Northeast Gulf: McLelland (1978, 1984), McLelland and Perry (1989 – as *M. decipiens*). Mexico: Mostajo (1978).

Open ocean – Kolesnikov (1966), Kolesnikov and Alfonso (1966), Every (1968), Alvario (1969).

Remarks

Some of the above-mentioned records and ecological notes may be inaccurate because of confusion with *M. sibogae*, a very similar species (see remarks for *M. sibogae*).

MESOSAGITTA MINIMA (Grassi, 1881)
(Figs. 8D, 12D)

Diagnosis

Mature body length 6–7 mm, widest at trunk-tail septum. Hooks 7–8. Anterior teeth 3–5. Posterior teeth up to 12. T% 15–22. Eye pigment small, slightly elongate, T-shaped (Fig. 12D). Small head with distinct neck. No collarette. Gut diverticulae small. Lateral fins delicate with sparse rays on outer margins. Anterior fins slightly separated from ventral ganglion. Posterior fins with 3/4 length on trunk segment. Mature ovaries short, with 3–4 large ova in one row. Seminal vesicles oval, widely separated from posterior fins, contacting caudal fin.

Ecology

Oceanic to semi-neritic, cosmopolitan in tropical and temperate regions where mixing of coastal and oceanic water occurs (Alvariño 1965; Boltovskoy 1981). Not a good hydrological indicator species because of its association with mixed water (Pierce 1953; Pierce and Wass 1962). Epiplanktonic to mesoplanktonic, shows affinity for cooler temperature (Alvariño 1965; Ducret 1968).

Gulf of Mexico records (*As Sagitta minima*)

Coastal – Florida: Maidana and Mostajo (1980). Northeast Gulf: Alvariño (1969), McLelland (1978, 1984), McLelland and Perry (1989 – as *M. minima*). Texas: Pierce (1962). Mexico: Mostajo (1978).

Open ocean – Every (1968), Alvariño (1969), Michel et al. (1976).

MESOSAGITTA SIBOGAE (Fowler, 1906)
(Figs. 8B,C; 12F)

Diagnosis

Body length at maturity 14–20 mm. Hooks 6. Anterior teeth 7–9. Posterior teeth 14–20. T% 19–27. Eye pigment elongate, T-shaped (Fig. 12F). No collarette. Prominent gut diverticulae. Anterior fins tapered, emerging level with posterior edge of ventral ganglion, with small rayless zone at anterior end. Posterior fins rounded, equally situated over trunk and tail segments, widest near posterior end, with small rayless zone at anterior end. Ovaries long, may extend past anterior fin, rounded at distal end; ova uniform in size, in one row. Seminal vesicles situated near caudal fin and widely separated from lateral fins, with a clear, bulbous inflation at anterior end.

Ecology

Oceanic, mesoplanktonic in mid and lower Atlantic latitudes. Probably distributed shallower in the mesopelagic realm than *M. decipiens*; apparently does not migrate diurnally (Pierrot-Bults 1979, 1982).

Gulf of Mexico records

McLelland and Perry (1989).

Remarks

Body length at maturity and seminal vesicle position are the major differences between this species and *M. decipiens*. Pierrot-Bults (1979) resurrected *Sagitta sibogae* after examining the lectotypes of *S. sibogae* and *S. decipiens*. Her detailed redescrptions of both species corrected the inadequacies of Fowler's (1905, 1906) original descriptions. Northeast Gulf specimens were compared to the lectotype of *S. sibogae* (ZMA 525-C, Siboga Exp., sta. 141) on loan from the Zoological Museum of Amsterdam.

SAGITTA BIPUNCTATA Quoy and Gaimard, 1827
(Figs. 9A, 12I)

Diagnosis

Body length at maturity 10–15 mm. Hooks 8–11. Anterior teeth 5–7. Posterior teeth up to 17. T% 24–27. Eye pigment slightly elongate (Fig. 12I). Collarette prominent to level of ventral ganglion, often extending entire length of body. No gut diverticulae. Lateral fins entirely rayed; anterior fin slightly separated from ventral ganglion. Mature ovaries long, may reach level of ventral ganglion; ova round, in one or two rows. Seminal vesicles well separated from posterior fins; anterior portion with clear, bulbous structure which sometimes contains a circular, saw-toothed inset.

Ecology

Oceanic, cosmopolitan in temperate to tropical water (Alvariño 1965). Epiplanktonic to upper mesoplanktonic (Owre 1960; Legaré and Zoppi 1961; Mattlin 1974). An indicator of high salinity, oceanic water (Pierce 1953; Grant 1963).

Gulf of Mexico records

Coastal – Cuba: Suárez-Caabro (1955). Florida: Ritter-Zahony (1910), Maidana and Mostajo (1980). Northeast Gulf: Alvariño (1969), Mulkana and McIlwain (1973), McLelland (1978, 1984), McLelland and Perry (1989).

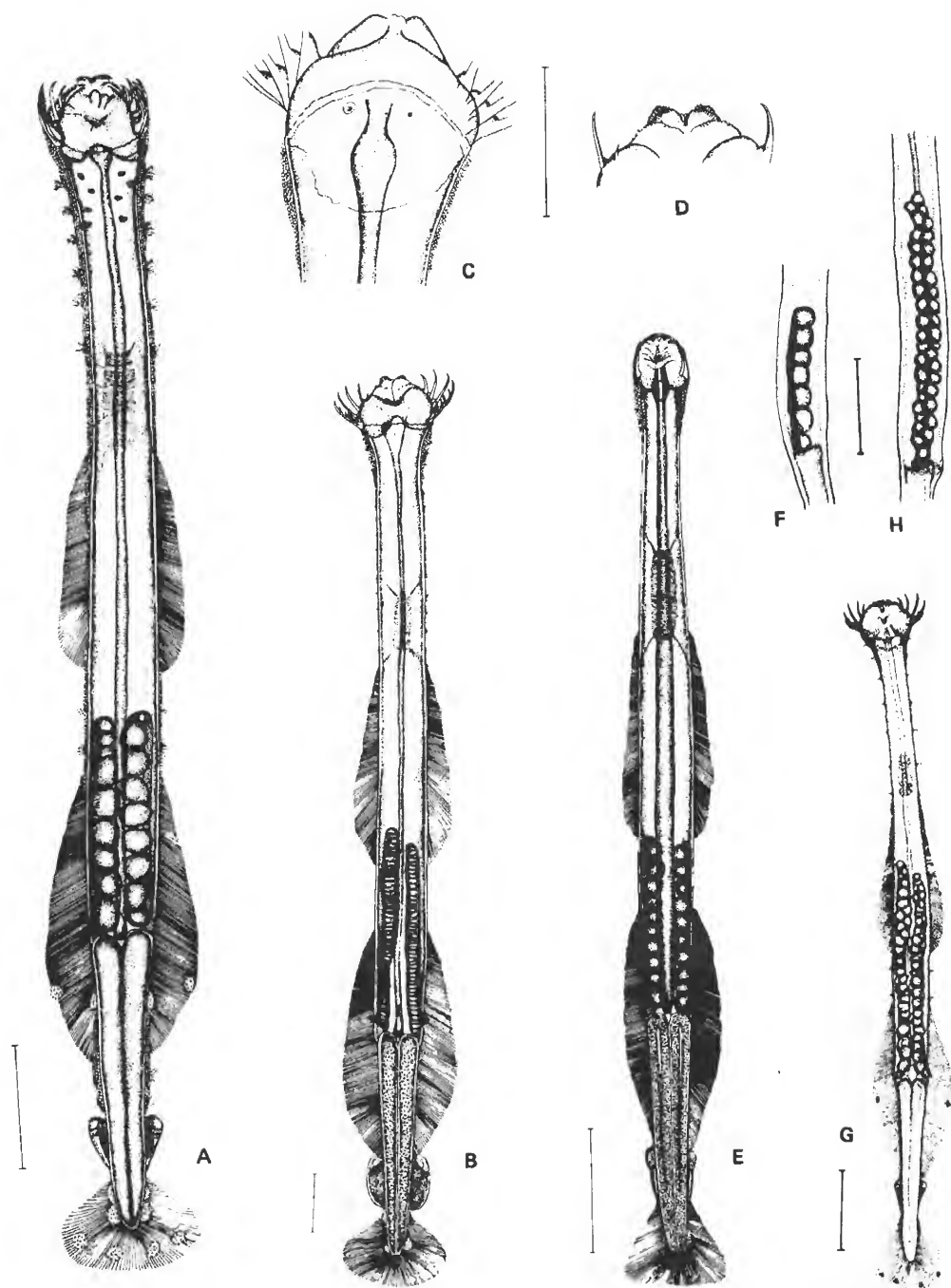


Figure 9. A, *Sagitta bipunctata*. B, C, D, *S. helenae*. E, F, *S. tenuis*. G, H, *S. friderici*. (A, B, E, G) whole animals, ventral view; (C) head, dorsal view; (D) anterior head, ventral view; (F, H) lateral view of ovaries. Scales = 1.0 mm.

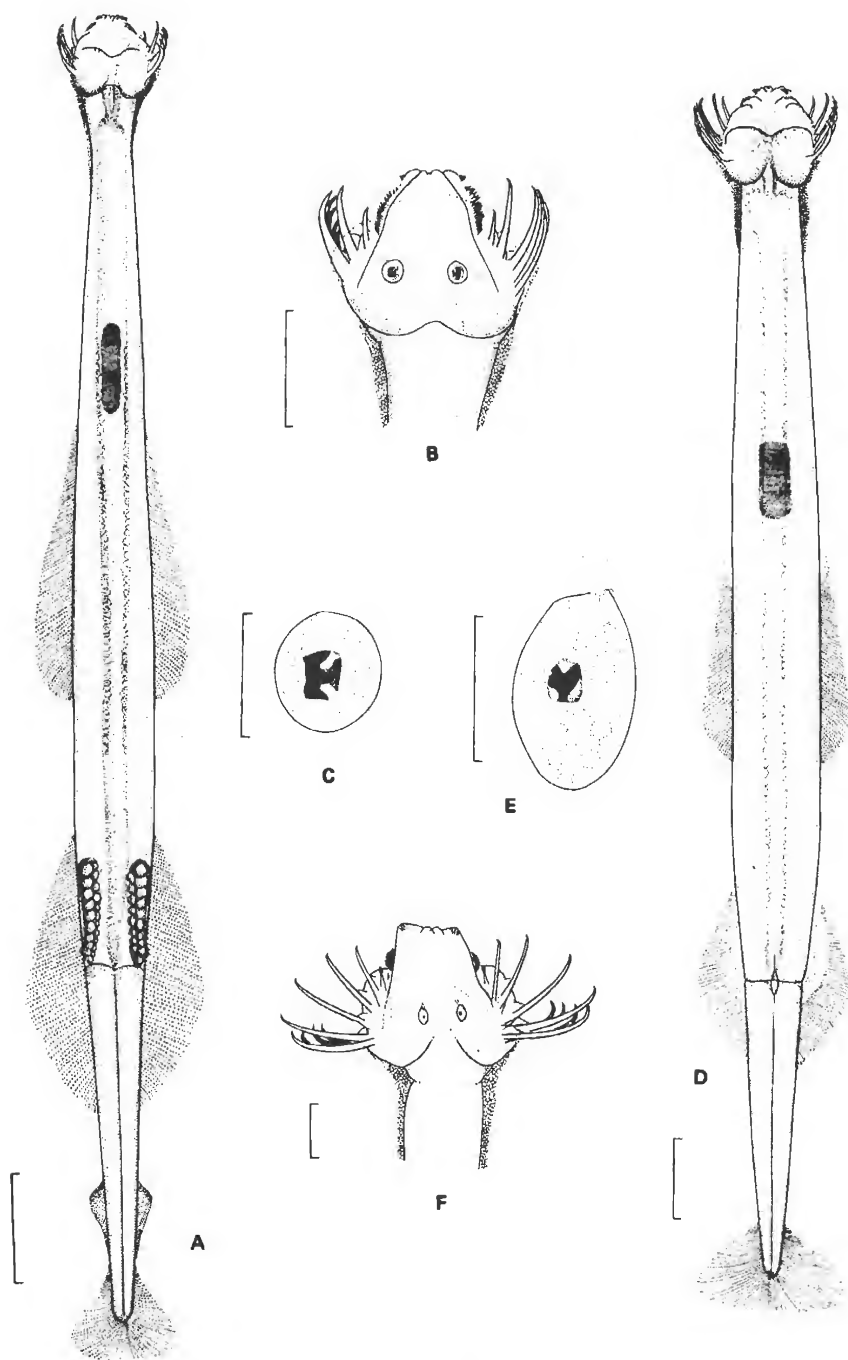


Figure 10. A-C, *Sagitta megalophthalma*. D-F, *Solidosagitta planctonis*. (A, D) whole animals, ventral view; (B, F) heads, dorsal view; (C) left eye; (E) right eye. Scales: A, D = 1.0 mm; B, F = 0.5 mm; C, E = 0.1 mm.

Open ocean – Pierce (1954), Kolesnikov (1966), Kolesnikov and Alfonso (1966), Every (1968), Alvaríño (1969), Owre (1973), Michel et al. (1976).

Remarks

The anterior teeth are similar in appearance and arrangement to those of *S. helenae* except they are less numerous and shorter.

SAGITTA HELENAE Ritter-Zahony, 1910 (Figs. 9B–D, 12L)

Diagnosis

Body length at maturity 9–13 mm. Hooks 7–8. Anterior teeth up to 19. Posterior teeth up to 15. T% 21–28. Eye pigment square (Fig. 12L). Collarite extending about half way to ventral ganglion. No gut diverticulae. Lateral fins entirely rayed; anterior fins emerge at posterior edge of ventral ganglion; posterior fins contact seminal vesicles. Mature ovaries may extend past ventral ganglion; ova cylindrical, in two rows. Seminal vesicles oval when ripe, contacting posterior and caudal fins.

Ecology

Neritic, epipelagic, in Atlantic tropical-subtropical regions (Alvaríño 1965; Boltovskoy 1981). Often associated with higher salinity continental shelf waters (Pierce 1951, 1953).

Gulf of Mexico records

Coastal – Florida: Ritter-Zahony (1910), Pierce (1951), Smith (1955), Hopkins (1966), Kelly and Dragovich (1968), Alvaríño (1969), Maidana and Mostajo (1980). Northeast Gulf: Alvaríño (1969), Shaw (1973), Mulkana and McIlwain (1973), Perry and Christmas (1973), McLelland (1978, 1984). Texas: Pierce (1962), Adelman (1967). Mexico: Mostajo (1978).

Open ocean – Every (1968), Alvaríño (1969).

SAGITTA FRIDERICI Ritter-Zahony, 1911 (Figs. 9G,H, 12J)

Diagnosis

Body length at maturity 9–13 mm. Hooks 7–9. Anterior teeth 5–9. Posterior teeth up to 22. T% 25–30. Eye pigment square (Fig. 12J). Collarite short at neck. No gut diverticulae. Lateral fins entirely rayed; anterior fin tapered, emerging level with posterior edge of ventral ganglion. Mature ovaries may

reach mid-point of anterior fins; ova small, round, in two rows (Fig. 9H). Mature seminal vesicles contacting posterior and caudal fins, possessing anterolateral circular processes.

Ecology

Neritic, epipelagic, widely distributed in coastal waters of Atlantic and adjacent seas (Alvaríño 1965; Michel et al. 1976). Usually associated with lower salinity, near-shore waters but able to tolerate oceanic salinities (Fumestini 1957; Fraser 1961; McLelland 1980).

Gulf of Mexico records

Coastal – Northeast Gulf: McLelland (1978, 1980, 1984). Mexico: Suárez-Caabro and Gomez-Aguirre (1965), Laguarda-Figueras (1967).

Remarks

Tokioka (1974) considers *S. friderici* and *S. tenuis* to be ecological forms of the same species, with *S. tenuis* being the typical form. He attributes the larger size (up to 19 mm) of *S. friderici* and other "forms" of *S. tenuis* to be characteristic of slower growth rates of "matured individuals" in colder water, whereas the smaller size of individuals in warmer water results from energy being transferred away from body growth toward ovary development to achieve rapid maturation rates. Mature specimens of the two species from the Northeast Gulf, although similar, are readily separated by the methods presented in this key. Sampling evidence seems to indicate overlapping habitats, given the occurrence of both species not only at the same locations, but often in the same sample (McLelland 1978, 1980, 1984).

SAGITTA MEGALOPHTHALMA

Dallot and Ducret, 1969
(Figs. 10A–C)

Diagnosis

Length at maturity up to 19.5 mm. Hooks 7–8. Anterior teeth 5–8. Posterior teeth 13–21. T% 22–29. Eye pigment distinctively large, rectangular (Fig. 10C). Collarite well developed at neck. Gut thickened at anterior end, resembling small diverticulae. Large vacuoles along exterior of gut walls for about 2/3 length of gut tube. Lateral fins completely rayed; anterior fins emerging posterior to ventral ganglion by a distance equal to 1/2 the length of the ganglion. Mature ovaries extending to anterior end of posterior fins; ova round, in three rows. Seminal vesicles ovoid, well separated from posterior fins.

Ecology

Oceanic, mesoplanktonic; reported from the western Mediterranean Sea (holotype from 100–800 m), the Tyrrhenian Sea, and Gulf of Guinea by Dallot and Ducret (1969). A few specimens have been collected in the Caribbean Sea where it is a suspected indicator of North Atlantic water (Michel et al. 1976) and in the Florida Straits (Stepien 1980).

Gulf of Mexico Records

McLelland and Perry (1989).

Remarks

The five specimens from a 200–500 m. Geryon Cruise sample represented a new record for the Gulf of Mexico. They were probably transported in the Loop Current from the Caribbean Sea.

SAGITTA TENUIS Conant, 1896
(Figs. 9E,F; 12K)

Diagnosis

Body length at maturity less than 7 mm. Hooks 7–8. Anterior teeth 5–7. Posterior teeth 10–16. T% 24–32. Eye pigment square (Fig. 12K). Collarette small at neck. No gut diverticulae. Lateral fins entirely rayed; anterior fin tapered, emerging level with posterior edge of ventral ganglion. Mature ovaries usually not reaching anterior fin; ova large, round, few in number, in one row (Fig. 9F). Mature seminal vesicles contacting posterior and caudal fins, possessing anterolateral circular processes.

Ecology

Euryhaline, associated with neritic waters in tropical, subtropical, and temperate Atlantic regions; epipelagic (Alvario 1965).

Gulf of Mexico records

Coastal – Cuba: Suárez-Caabro (1955). Florida: Pierce (1951), Smith (1955), Hopkins (1966), Kelly and Dragovich (1968), Alvario (1969), Maidana and Mostajo (1980). Northeast Gulf: Alvario (1969), Mulkana and McIlwain (1973), Perry and Christmas (1973), McLelland (1978, 1980, 1984). Texas: Pierce (1962), Adelman (1967). Mexico: Vega-Rodriguez (1964, 1965), Mostajo (1978).

Remarks

Recorded occurrences of *S. tenuis* from Gulf of

Mexico and coastal Atlantic regions may include *S. friderici* owing to Pierce's (1951) placing the two species in synonymy (McLelland 1980). Juveniles and sub-adults of the two species cannot be confidently separated.

SERRATOSAGITTA SERRATODENTATA

(Krohn, 1853)

(Figs. 11A–D)

Diagnosis

Body length at maturity 10–13 mm. Hooks 5–8. Anterior teeth 6–10. Posterior teeth 15–20 (mature). T% 23–28. Eye pigment elongate, T-shaped (Fig. 11D). Collarette vestigial, usually not distinct at neck. No gut diverticulae. Anterior fins emerging at posterior end of ventral ganglion, with small internal rayless zone. Posterior fins "bell" or "guitar" shaped, with internal rayless zone. Mature ovaries extending to anterior fins; ova round to cuboidal, in one row. Seminal vesicles contacting lateral fins, separated from caudal fin, with two anterolateral papillae, or "horns", when mature. Hooks finely serrate on inner margins with serrata being low in profile (Fig. 11B).

Ecology

Oceanic, epipelagic, inhabits tropical and subtropical waters of Atlantic and adjacent seas (Alvario 1965; Boltovskoy 1981). Usually associated with high salinity but has been known to tolerate low salinity coastal water, especially in temperate regions (Pierce and Wass 1962).

Gulf of Mexico records (As Sagitta serratodentata)

Coastal – Cuba: Suárez-Caabro (1955). Florida: Ritter-Zahony (1910), Alvario (1969), Maidana and Mostajo (1980). Northeast Gulf: Alvario (1969), Mulkana and McIlwain (1973), McLelland (1978, 1984), McLelland and Perry (1989 – as *Serratogagitta serratodentata*). Texas: Pierce (1962), Adelman (1967). Mexico: Vega-Rodriguez (1964, 1965), Mostajo (1978).

Open ocean – Pierce (1954), Kolesnikov (1966), Kolesnikov and Alfonso (1966), Every (1968), Alvario (1969), Michel et al. (1976).

Remarks

According to Pierrot-Bults' (1974) classification, the Gulf population belongs to the Atlantic subspecies *Sagitta serratodentata serratodentata* Krohn, 1853 as opposed to the subspecies *S. serratodentata atlantica* Thompson, 1947, an isolated population in the South Pacific. A compound microscope is usually required to observe hook serrata in smaller specimens.

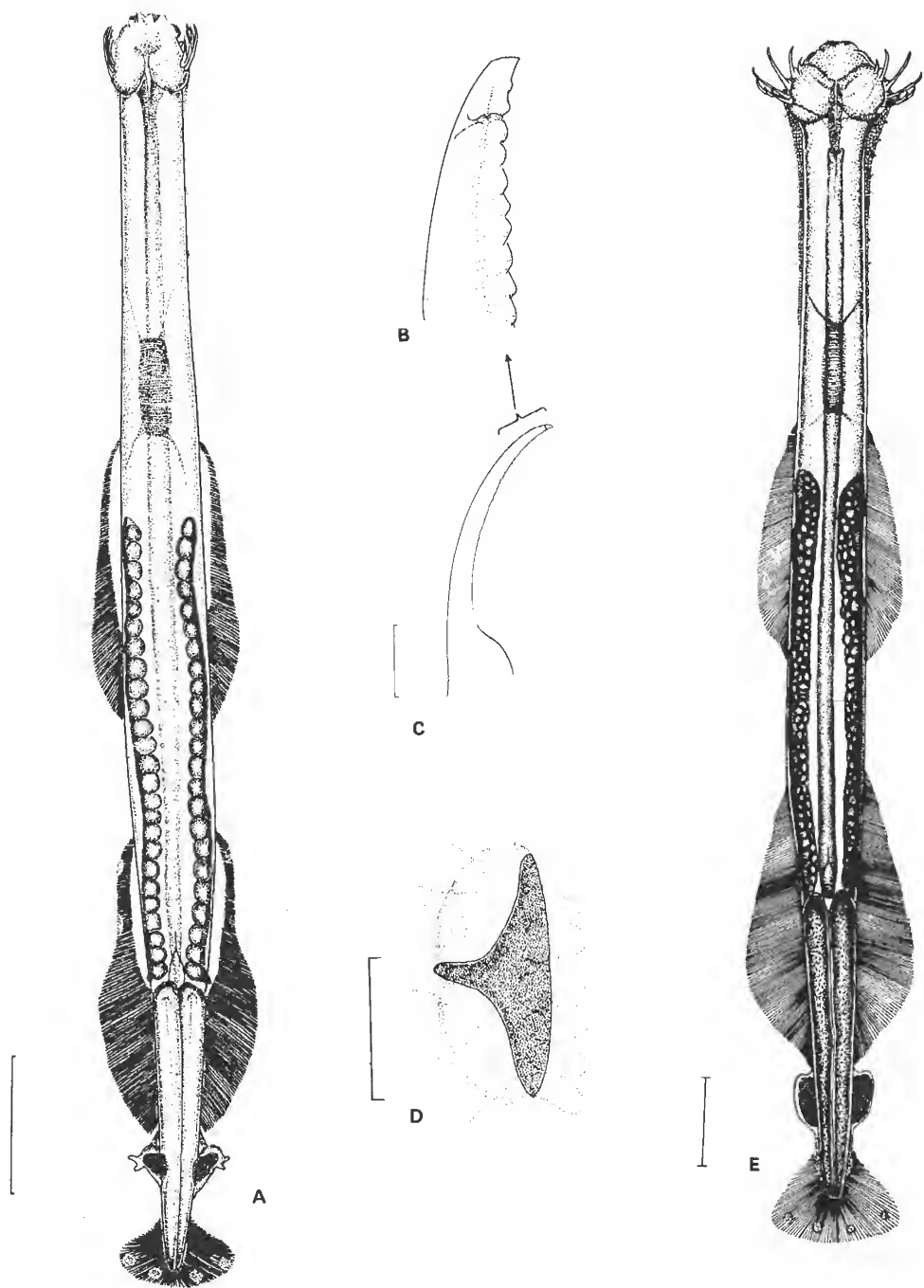


Figure 11. A-D, *Serratosagitta serratodentata*. E, *Ferosagitta hispida*. (A, E) whole animals, ventral view; (B) hook detail; (C) hook; (D) right eye pigment. Scales: A, E = 1.0 mm; C = 0.1 mm; D = 0.01 mm.

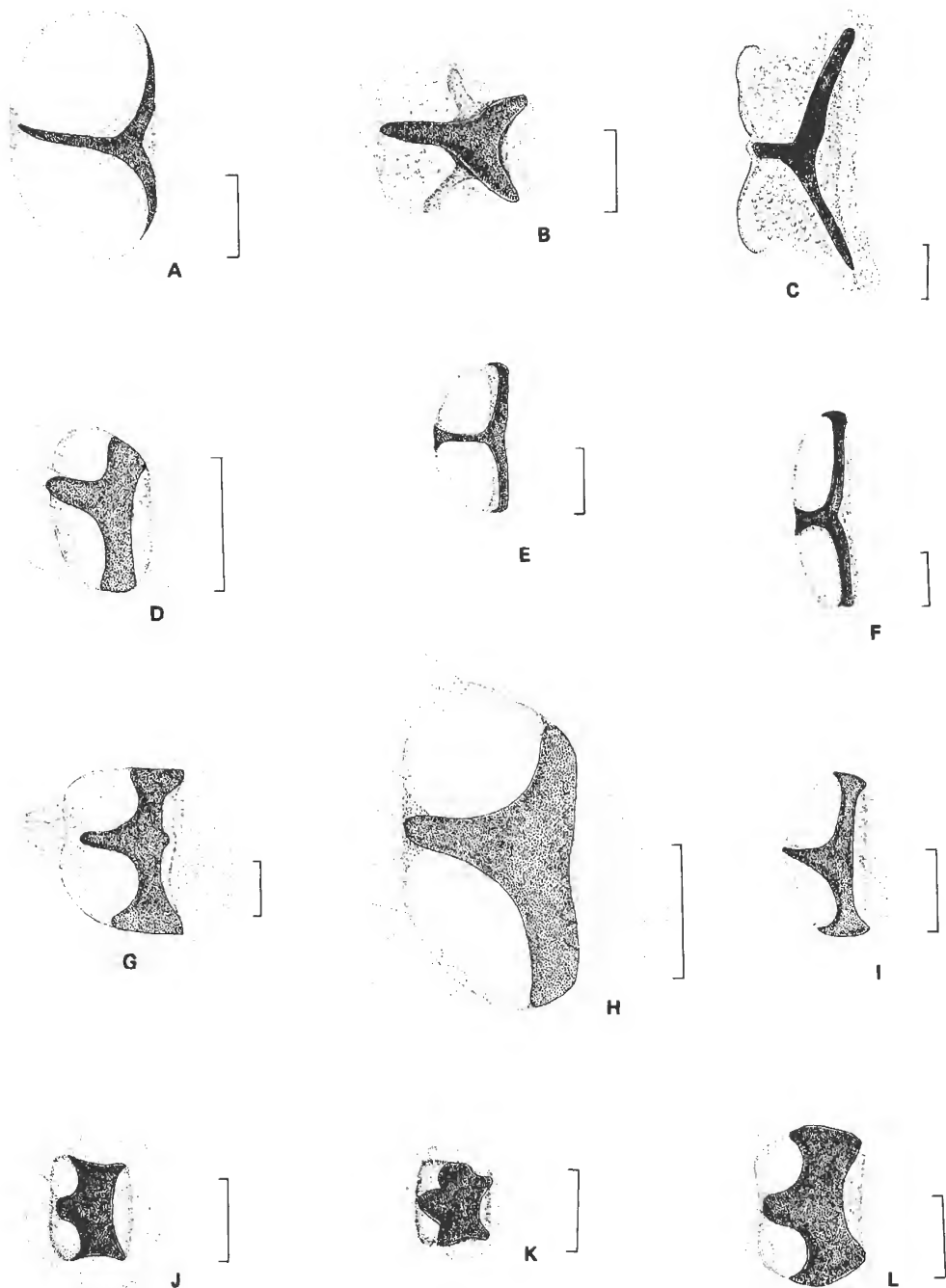


Figure 12. Chaetognath eye pigments, all from right eyes. (A) *Flaccisagitta hexaptera*, (B) *F. enflata*, (C) *F. lyra*, (D) *Mesosagitta minima*, (E) *M. decipiens*, (F) *M. sibogae*, (G) *Ferosagitta hispida*, (H) *Pterosagitta draco*, (I) *Sagitta bipunctata*, (J) *S. friderici*, (K) *S. tenuis*, (L) *S. helenae*. Scales: C, D, E, G, H = 0.01 mm; A, B, I, J, K, L = 0.015 mm; F = 0.02 mm.

SOLIDOSAGITTA PLANCTONIS (Steinhaus, 1896)
(Figs. 10D–F)

Diagnosis

Length at maturity 30–43 mm. Hooks 8–11. Anterior teeth 5–12. Posterior teeth 10–22. T% 20–30. Eye pigment small, square (Fig. 10E). Collarlet well developed. Gut diverticulae present. Large vacuoles present in body cavity associated with gut tube. Anterior fins emerging level with posterior end of ventral ganglion, with rayless anterior ends. Posterior fins triangular with rayless interior, 1/3 of length on tail segment. Mature ovaries long; ova small, in three rows. Seminal vesicles oval, situated adjacent to posterior fins, well separated from caudal fin.

Ecology

Oceanic, mesoplanktonic, cosmopolitan in tropical and temperate waters (Alvarinho 1965; Terazaki and Marumo 1982). Collected in the Florida Straits at 687 m (Stepien 1980) and throughout the Caribbean Sea down to 3000 m (Michel et al. 1976) where it is considered an indicator of North Atlantic water.

Gulf of Mexico Records

Coastal – Northeast Gulf: McLelland and Perry (1989).

Open ocean – (as *Sagitta zetesios*) Southeast Gulf near Yucatan Straits: Fagetti (1968)

Remarks

Using discriminant and factor analyses on specimens of *Sagitta planctonis* and *S. zetesios* Fowler, 1905, collected from the southwest African coast and Bermuda, Pierrot-Bults (1975) demonstrated that the

species should be considered polytypic with two "formae", *S. planctonis* f. *planctonis* and *S. planctonis* f. *zetesios*, with the latter being associated with deeper, colder water. She showed that both forms, and intermediates between the two, are often present in the same population; thus, no firm barriers exist preventing gene flow between forms. The five immature specimens (8.4–16.4 mm) from the Geryon material corresponded to the form *zetesios*, as described by Pierrot-Bults (1975) and Michel (1984). It is likely that the other form, *S. planctonis* f. *planctonis*, occurs in the Gulf of Mexico since a few specimens were collected in the Caribbean Sea (Michel et al. 1976) and the Florida Straits (Owre 1960). Although Pierrot-Bult's synonymization of the two species is accepted, the legality of the taxon "forma" is questionable; thus, only the species nomenclature, *planctonis*, is retained in this work. The reader is referred to David's (1956) redescription of the two species as argument for maintaining the validity of *planctonis* and *zetesios*.

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The Growth of Cultchless *Crassostrea virginica* Spat at Biloxi Bay, Mississippi Using Different Methods of Culture

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THE GROWTH OF CULTCHLESS *CRASSOSTREA VIRGINICA* SPAT AT BILOXI BAY, MISSISSIPPI USING DIFFERENT METHODS OF CULTURE

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ABSTRACT Oyster spat produced from the experimental hatchery of the Gulf Coast Research Laboratory at Point Cadet, Biloxi, Mississippi, were grown under a variety of conditions. Recovery of spat planted on adjacent bay bottom was negligible, despite the use of either whole oyster valves, crushed oyster shell or clam shell as a substrate. Negligible growth occurred for spat held in vertical and horizontal water tanks. Growth of spat in horizontal tanks was affected by the density of stocking, with lower densities producing faster growth. Growth in all studies was slower than anticipated and a comparison on growth for spat from a Maryland hatchery with locally-produced spat suggests that the low growth was related to the local waters. Overall, growth as determined by increase in greatest shell dimensions of spat is as follows: on-bottom, 2.90 mm/mo; raft culture, 1.78 mm/mo; upwelling tank, 1.19 mm/mo; and horizontal trough, 2.0 mm/mo.

INTRODUCTION

One effect of the decline in oyster production in the United States has been the development of oyster hatcheries. New techniques for handling spat developed at these hatcheries include the production of cultchless seed oysters. These cultchless seed are easier to handle and ship, but as yet, adequate field techniques have not been developed for grow-out of these seed. Few of the small spat planted on bottom in any of the various states have been recovered. Reasons suggested for this poor survival are that spat are washed away by currents, silted in or consumed by crabs. One possible solution to the problem would be to plant larger seed oysters for which adequate field experience is available, but this requires the development of a nursery system for raising cultchless spat (1-25 mm in height) to seed (26-50 mm in height). In the present study, growth of hatchery reared spat was slow in all treatments. To determine possible reasons for the slow growth, the effect of density on growth of spat held in trays was determined. Additionally, the growth of cultchless spat from another hatchery was compared with the growth of spat from our hatchery.

MATERIALS AND METHODS

Unless otherwise noted, cultchless spat were produced according to the procedure of Dupuy, Windsor and Sutton (1977) at the Oyster Biology Research Facility (OBRF) hatchery located on Point Cadet in Biloxi, Mississippi. Treatments of the various spat were: (1) on bottom, planted adjacent to the hatchery; (2) raft culture, placed in trays suspended in the bay;

and (3) upwelling, placed in trays in a deep tank receiving vertically upflowing bay water. In the next three treatments, the spat were all placed in troughs receiving horizontally flowing bay water to be referred to as: (4) horizontal; (5) density, varying numbers placed in Nestier trays; and (6) Maryland versus OBRF spat. The final treatment was (7) pond, a tank containing static water (Figure 1).

1. On-bottom Growth Study

During low tide on December 23, 1976, 1,600 spat were planted on bottom in 16 one-square-meter plots at a density of 100 spat per plot. The plots were prepared in Biloxi Bay on cleared bottom in a matrix of four treatments consisting of bare mud, clusters of whole oyster shells, crushed oyster shells, and clam shells. A wooden weir was constructed on the outer sides of the plots to protect them from wave action.

2. Raft Culture Growth Study

In September 1976, 100 spat were placed in each of three Nestier trays stacked vertically and suspended off a pier adjacent to the bottom plots in Biloxi Bay.

3. Upwelling Growth Study

Also in September 1976, 600 spat were distributed inside the hatchery into six trays containing 100 oysters per tray, stacked vertically into a 1.5 m² tank receiving pumped bay water in an updraft flow.

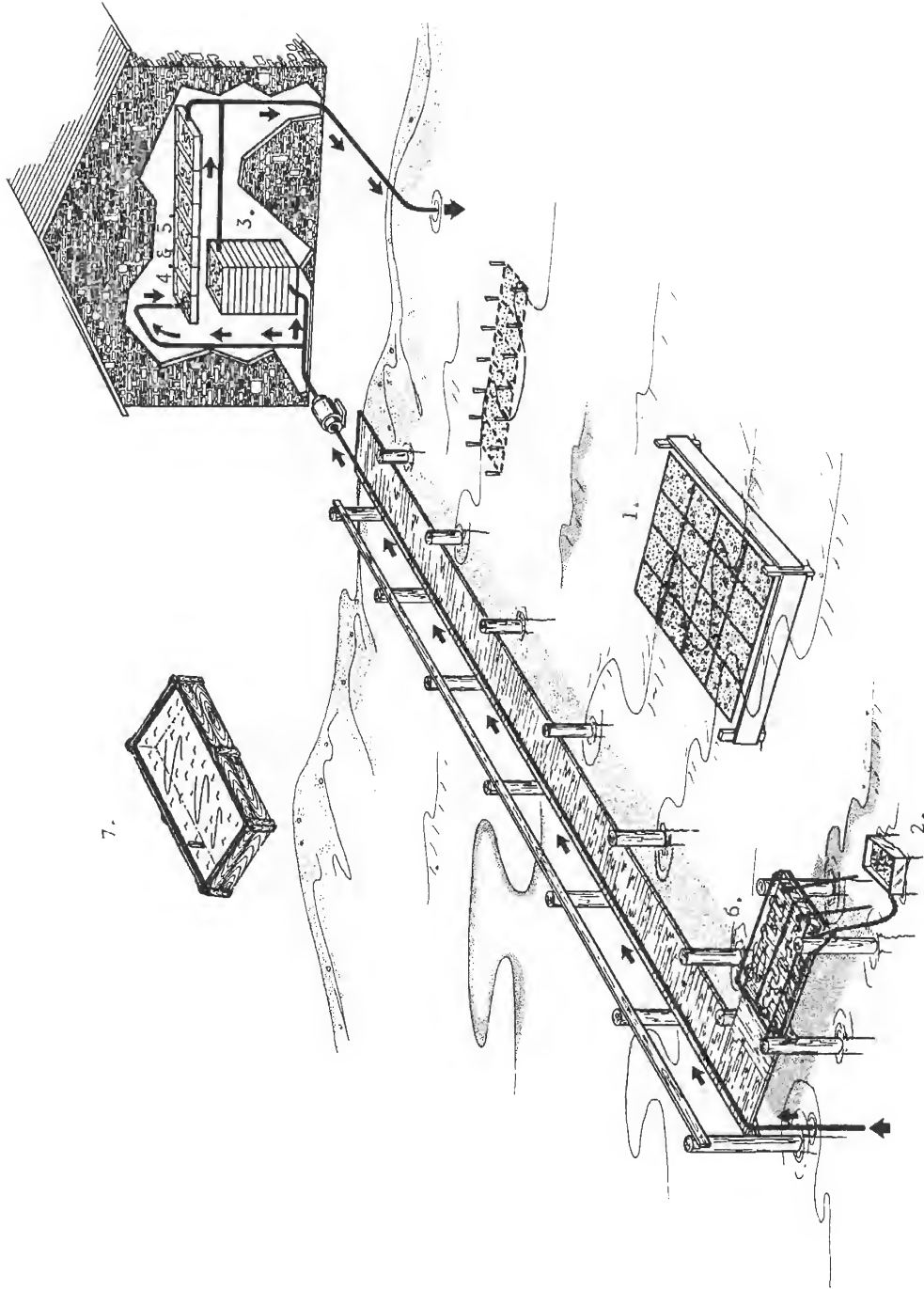


Figure 1. Diagram representing various treatments of oysters used in this study. (1) On-bottom, (2) Raft culture, (3) Upwelling, (4) Horizontal, (5) Density, (6) Maryland vs. local, and (7) Pond.

4. Horizontal Growth Study

During September 1976, an additional 600 spat were placed inside the hatchery into six trays (100 oysters per tray) distributed linearly in a 3.7 m long water trough receiving pumped bay water at one end (Figure 1). Flow rates were determined daily and the system adjusted as required to maintain a flow equal to that of the upwelling treatment above (3).

5. Density Growth Study

In February 1977, 4,200 cultchless spat were placed in a horizontal trough and distributed into six trays sequentially from one end in the following numbers per tray: 100, 400, 1,600, 100, 400, 1,600.

6. Maryland vs. OBRF Growth Study

In October 1977, a tray of 100 spat from the OBRF hatchery and a tray of 100 spat from a hatchery in Maryland (Horn Point Environmental Laboratory, P.O. Box 775, Cambridge, Maryland 21613) were placed into separate troughs receiving horizontally-flowing bay water at equal rates.

7. Pond Growth Study

In March 1979, 100 oyster spat averaging 19.6 mm were placed in a rectangular box (1.8 x 3.6 m) constructed of wood framing supporting a plastic liner and filled with approximately 8,000 liters of 15 parts per thousand (ppt) bay water. A dense bloom of phytoplankton imparted a green color to the "pond" water. The oyster spat held in a Nestier tray suspended above the pond bottom were recovered monthly for measuring during the six month study.

In all treatments, the oysters were measured monthly for the greatest shell dimension (umbo to bill) or height (Galtsoff 1964) using calipers read to the nearest mm. Data were recorded and a mean and standard deviation calculated monthly. In trays containing more than 100 oysters, 100 were arbitrarily selected to be measured. Ambient bay water temperature entering the tanks was determined to the nearest degree C with a mercury thermometer and salinity was determined with a refractometer in ppt on a daily basis.

RESULTS

In treatments one through four, the salinity of the bay water ranged from 2 ppt during March 1977 to 28 ppt during July 1977 (Figure 2). The temperature of the bay water ranged from a low of 5°C during Jan-

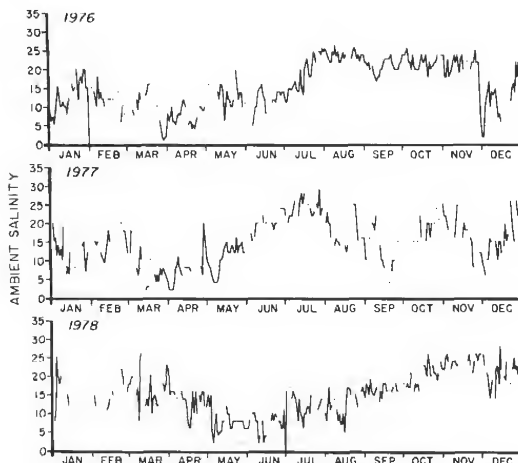


Figure 2. Ambient salinity for Biloxi Bay, Biloxi, Mississippi recorded daily 1976 - 1977.

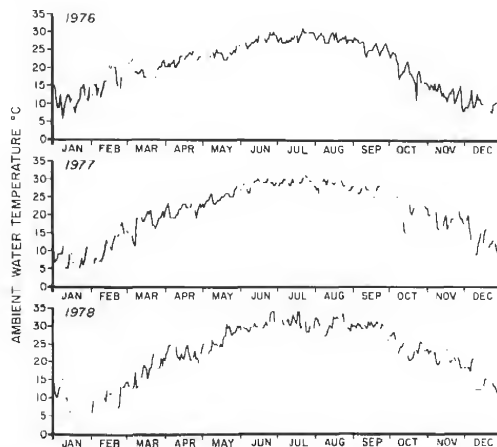


Figure 3. Ambient water temperatures for Biloxi Bay, Biloxi, Mississippi recorded daily 1976 - 1978.

uary 1977 to a high of 31°C during July 1977 (Figure 3). In treatment five, the bay water salinity varied from 2 ppt during March 1977 to 28 ppt during July 1977 (Figure 2). Bay water temperature varied from a low of 6.5°C during February 1977 to a high of 31°C during July 1977 (Figure 3). In treatment six, the bay water salinity varied during the course of the Maryland vs. OBRF spat study from a low of 2 ppt in June 1978 to a high of 26 ppt in December 1977 and October 1978 (Figure 2). The bay water temperature varied from a low of 5°C in January and February 1978 to a high of 34°C in July 1978 (Figure 3).

1. On-bottom

After one year, none of the 1,600 spat planted on the bottom were recovered.

2. Raft culture

Spat placed in stacked Nestier trays suspended off the pier grew an average of 1.78 mm per month (Table 1) during the 11 month period (September 1976 – July 1977). These spat increased from an average of 12.9 mm to a final average length of 32.0 mm. Of the original 300 spat, only 31 individuals or 10% were recovered.

3. Upwelling

Spat placed in the vertical upflow tank grew an average of 1.19 mm per month, increasing from an average initial size of 14.1 mm to a final length of 25.9 mm over a 10 month period (September 1976 – June 1977). Of the original 600 spat in the vertical upflow tank, 349 survived (58%). Water flow varied daily, ranging from 2 to 22 liters per minute throughout the study.

4. Horizontal

Spat placed in the horizontal tank grew 2.0 mm per month, increasing from 13.8 mm to 35.7 mm in 11 months (September 1976 – July 1977). Of the original 600 spat, 167 survived (27.8%). Water flow varied daily, also from 2 to 22 liters per minute, throughout the study.

5. Density

Growth of spat placed in the horizontal tank at three densities was greatest near the water inlet and least near the water outlet. With one exception, the tray containing 100 spat which was located fourth tray from the inlet, growth decreased in relation to relative distance from the water inlet. Spat ranged in size from 24.4 mm to 39.3 mm after eight months, (February – September 1977), representing a range in growth of from 1.56 mm to 4.15 mm per month (Table 1). Growth also decreased as a function of increased density. Water flow through the water trough ranged from 8 to 15 liters per minute.

6. Maryland vs. OBRF

Oyster spat from the GCRL hatchery grew slightly faster than did those spat from the Maryland hatchery (1.9 mm per month vs. 1.68 mm per month). Spat from the OBRF hatchery increased from an initial size of 16.1 mm to 40.8 mm, while the spat from the

Maryland hatchery increased from an initial size of 16.4 mm to a final size of 38.3 mm from October 1977 to October 1978 (Table 1). Of the original 100 spat from each location, 82 of the Maryland spat survived and 61 of the GCRL spat survived.

7. Pond

The oyster spat stocked into the saltwater pond did not grow. In fact, due to mortality, the average size decreased over the period March through August 1979 (Table 1). The spat were stocked at an initial average size of 19.6 mm, and after six months the average size was 19.4 mm with a survival of 84%.

DISCUSSION

The failure to recover any of the oysters planted on the bottom was not surprising. Even though an attempt was made to protect the planting from wave action, later studies in the same area indicate that shells are transported (Ogle and Chestnut 1979), and even small blue crabs are capable of opening fairly large spat (Ogle 1978) and will consume oyster spat during most of the year (Ogle 1980a).

Growth of the oyster *Crassostrea virginica* in the northern Gulf of Mexico is known to be rapid. Menzel (1951) has reported growth rates for oysters from Florida as high as 11 mm to 25 mm per month. Ingle (1951) reported growth rates of 13.5 mm per month for oysters from the same area in Florida, while Ingle and Dawson (1952) reported a growth rate of only 5.6 mm per month. Hofstetter (1977) has reported growth rates for oysters from Texas as 6.3 mm per month. Gunter (1951) reported growth of oysters on offshore platforms as ranging from 5.1 mm to 8.1 mm per month. The Louisiana oyster industry requires that a commercial size, three inch (76.2 mm), animal be produced in 18 months in order to minimize loss from disease. This means that a minimum growth of 4.2 mm per month must be maintained, although none of the animals in this study achieved that rate of growth. In the raft culture experiment, growth (1.78 mm per month) of oysters suspended off the pier would require 3.5 years to produce a marketable oyster. Growth of oysters in the trays suspended from the pier may have been reduced due to agitation from boat traffic and wave action. Turbulence may have reduced estimates of growth due to breakage of the rapidly growing shell edges caused by the oysters rolling around in the trays as has been reported for oysters cultured in trays suspended from offshore oil rigs (Ogle, Ray & Wardle 1977, 1978). Indeed, in a study reported later, Ogle and Chestnut (1979) found that growth of oysters planted on bottom and adjacent to the pier was 2.9 mm per month. The growth rate of 1.19 mm per month from the upwelling tank and the

TABLE 1

Average size and standard deviation (in parentheses) of *Crassostrea virginica* spat measured monthly with a calculated growth rate in mm/mo.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	\bar{X} mo
1976													
					Treatment 2		raft culture		12.9 (1.71)	15.9 (2.91)	19.61 (3.92)	20.9 (4.07)	
					Treatment 3		upwelling tank		14.1 (2.86)	19.2 (4.09)	21.5 (4.33)	19.6 (3.92)	
					Treatment 4		hori- zontal trough		13.8 (2.14)	19.0 (3.98)	21.8 (4.23)	21.7 (3.88)	
1977													
	raft culture	21.1 (4.18)	22.2 (3.25)	23.3 (3.34)	23.0 (3.24)	24.9 (3.81)	25.5 (3.31)	32.0 (5.09)					1.78
	upwelling tank	23.1 (4.74)	22.8 (4.45)	22.9 (4.64)	23.3 (5.34)	23.3 (4.06)	25.9 (5.79)						1.19
	horizontal trough	22.5 (4.29)	23.8 (4.78)	23.1 (4.55)	22.5 (4.26)	23.5 (4.17)	27.2 (4.82)	35.7 (6.72)					2.0
Treatment 5 density study	100A	10.2 (2.35)	11.2 (2.51)	11.5 (2.60)	12.2 (2.47)	12.2 (3.21)	20.1 (3.21)	37.1 (6.12)	39.3 (5.87)				4.15
	400A	10.7 (2.11)	11.3 (2.49)	12.4 (2.09)	11.8 (2.38)	17.1 (3.42)	17.1 (3.42)	37.2 (5.78)	37.8 (7.14)				3.87
	1600A	10.7 (1.84)	21.1 (1.7)	12.2 (1.61)	12.6 (2.24)	17.1 (4.40)	17.1 (4.40)	30.8 (5.09)	31.8 (5.96)				3.00
	100B	10.4 (2.20)	11.3 (2.50)	11.3 (2.18)	12.0 (2.37)	14.9 (2.78)	14.9 (2.78)	24.1 (4.75)	24.6 (5.12)				1.96
	400B	10.4 (2.05)	12.1 (1.95)	11.8 (1.70)	12.9 (2.14)	17.0 (3.54)	17.0 (3.54)	25.9 (4.35)	27.0 (3.89)				2.22
	1600B	11.3 (2.27)	12.0 (2.24)	12.2 (2.04)	13.2 (1.94)	16.1 (4.10)	16.1 (4.10)	22.3 (4.40)	24.4 (4.09)				1.56

TABLE 1 (Continued)

Average size and standard deviation (in parentheses) of *Crassostrea virginica* spat measured monthly with a calculated growth rate in mm/mo.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	\bar{X} mo
1978	OBRF spat vs Mary- land spat	21.1 (3.68)	21.5 (3.37)	23.4 (4.03)	25.2 (4.46)	25.6 (4.69)	28.3 (5.10)	33.0 (4.94)	33.1 (5.04)	38.0 (5.94)	40.8 (6.71)	16.1 (2.16)	1.90
		22.3 (3.02)	22.0 (3.63)	24.2 (4.51)	28.5 (4.50)	30.0 (4.28)	31.3 (4.02)	34.2 (4.25)	33.5 (3.94)	35.6 (4.27)	38.3 (4.38)	16.4 (2.35)	1.68
								Treatment 6	OBRF spat vs Mary- land spat			19.4 (3.61) 21.8 (3.57)	
1979	Treatment 7	Pond	19.6 (2.72)	20.4 (2.93)	19.6 (2.71)	18.7 (2.83)	19.1 (2.65)	19.4 (2.66)					0

growth rate in the horizontal flow tank of 2.0 mm per month would require a growth period of 5.3 and 3.2 years, respectively, to produce a marketable oyster. The slow growth of the oysters inside receiving pumped water was unexplained. The greater number of oysters (600 versus 300) inside may have limited food; however, the growth of oysters from the density study produced substantially greater growth rates (4.15 mm per month). Growth was reduced as a function of increasing distance from the water inlet and increasing numbers of oysters. Growth was still 3.00 mm per month in the middle of the tank after the incoming water had passed over 500 oysters. Growth was again reduced in the study comparing OBRF oysters with those from a Maryland hatchery (1.90 mm versus 1.66 mm per month), even though there were only 200 oysters in the entire tank. No growth was recorded in the static pond. Eymard and Ancelet (1979) compared oyster growth in a large pond with oyster growth in an adjacent canal and reported little growth in the pond (1.00 mm per month).

It appears from this study that even though the OBRF site is an excellent one for reproducing oysters, (Ogle 1980b and Ogle 1982), it is not optimum for growing oysters inside the hatchery. In a later study

(McGraw 1980) comparing oyster growth at five locations in Mississippi Sound, growth at the Biloxi Bay was reported as 2 mm per month. That growth rate was exceeded at two of the other sites (Davis Bayou, 2.1 mm per month and Horn Island, 3.3 mm per month). Growth of spat from a location in the Western Sound (Pass Christian) was reported by MacKenzie (1977) as 6.57 mm per month although Ogle (1980c) found growth rates of oysters at Horn Island were more rapid than at Pass Christian.

It is recommended that oysters can be produced at this location on Biloxi Bay, but the grow-out should be at a different location or an effort undertaken to supplementally feed the spat until they are planted out.

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RECORDS OF DEEP-WATER CHAETOGNATHS FROM THE NORTHERN GULF OF MEXICO

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ABSTRACT Fourteen species of deep-water Chaetognatha were present in plankton samples collected between 200 and 677 m at five stations along the continental slope of the northern Gulf of Mexico. Samples were taken in conjunction with the MARFIN Geryon cruises of 1987 and 1988. New Gulf of Mexico records resulting from this study were *Eukrohnia calliops*, *Eukrohnia proboscidea*, *Mesosagitta sibogae*, and *Sagitta megalophthalma*. Other deep-water species present were *Eukrohnia fowleri*, *E. bathypelagica*, *E. bathyantartica*, *Caecosagitta macrocephala*, *Mesosagitta decipiens*, *M. minima*, *Solidosagitta planctonis*, *Krohnitta subtilis*, *Flaccisagitta hexaptera*, and *F. lyra*. In addition, the normally epiplanktonic taxa, *Pterosagitta draco*, *Serratosagitta serratodentata*, and *Sagitta bipunctata* occurred in some of the samples.

INTRODUCTION

Mesoplanktonic (those occurring between 200 and 1000 meters) and bathyplanktonic species of Chaetognatha (those occurring below 1000 meters) are mostly cosmopolitan in nature, being associated with and transported about by specific undersea currents. Although the coastal epiplanktonic chaetognath fauna of the northern Gulf of Mexico has been well documented (Pierce 1951, 1962; McLelland 1984), the deeper offshore species remain poorly known because of the difficulty and expense of gathering material for study. An opportunity to study deep-water chaetognaths recently arose when plankton samples were collected over the continental slope in the northern Gulf of Mexico as part of an effort to provide data on the distribution of larvae of the deep-water crabs, *Geryon fenneri* and *G. quinquedens*. This paper provides documentation of deep-water chaetognath species in the northern Gulf of Mexico by recording the presence and relative abundance of 14 mesoplanktonic and bathyplanktonic taxa found in samples collected below 200 meters. In addition, three epiplanktonic (0-200 m) species also occurred in the samples.

MATERIALS AND METHODS

Plankton samples were collected at five sampling areas along the continental slope of the northern Gulf of Mexico (Figure 1) during the MARFIN Geryon cruises of 1987 and 1988. Closing nets (1 m, 333 μ m mesh) equipped with Niskin double-trip devices were towed between 200 and 500 m to sample the water column above the crab traps. In addition, 0.3 m, 183 μ m mesh nets designed to passively filter the

current for 24 hours were attached to crab trap arrays resting on the bottom at 677 m.

Catch data indicating distribution and relative abundance of chaetognath species caught during the Geryon cruises and hydrographic data collected near the bottom of the water column are presented in Table 1. Chaetognaths were removed, identified to species, and counted from a total of 32 samples, 27 towed and five bottom net. In some cases, numbers of specimens were estimated because of large, unmanageable sample volumes and damaged specimens.

RESULTS AND DISCUSSION

The bottom nets, being smaller in diameter and stationary, filtered less water and thus captured fewer numbers of chaetognaths than the towed nets; however, they usually produced samples with a greater diversity of species than towed samples from the same areas.

Of the 14 deep-water species recorded, six were present in at least 22 of the 32 samples analyzed: *Mesosagitta sibogae* (30 samples), *Krohnitta subtilis* (29 samples), *Flaccisagitta hexaptera* (29 samples), *F. lyra* (24 samples), *F. decipiens* (24 samples), and *M. minima* (22 samples). Of these, *M. sibogae* was most often the dominant species, with *K. subtilis* second and *F. lyra* third in abundance.

Eukrohnia bathypelagica, present at all five sampling areas (14 samples), was the most common of the five *Eukrohnia* species present, while the two rarest, *E. bathyantartica* and *E. proboscidea*, occurred only once, in the same sample at Area 5.

Three normally epiplanktonic species, *Sagitta bipunctata*, *Pterosagitta draco*, and *Serratosagitta serratodentata*, occurred sporadically in the samples,

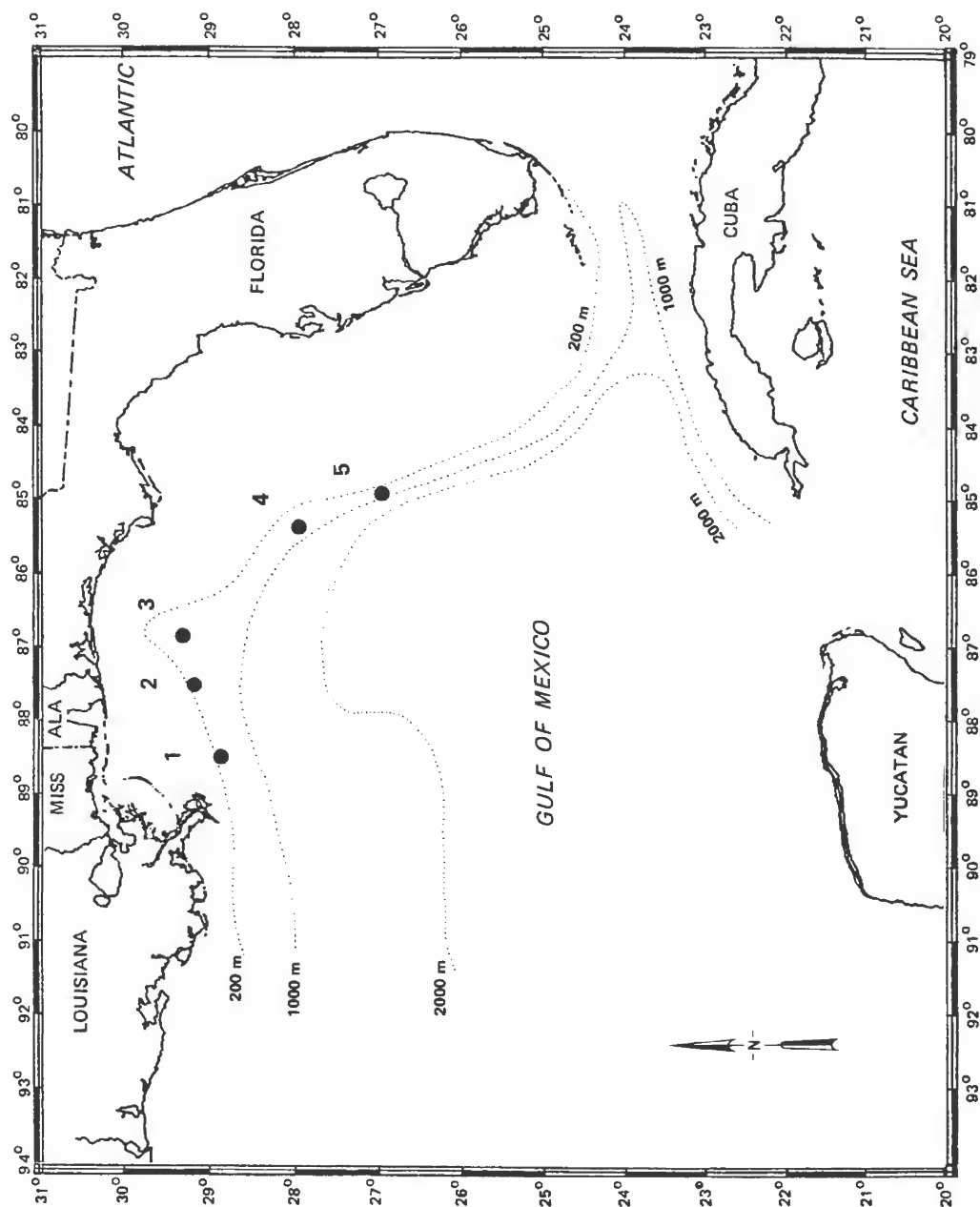


Figure 1. Locations of MARFIN - *Geryon* sampling areas in the Gulf of Mexico.

TABLE 1
Station and Hydrographic Data for the MARFIN-Geryon deep-water plankton collections in the northern Gulf of Mexico and the relative abundance of chaetognaths in the samples

Sta- tion	Posi- tion	Date	Time	Bot- tom depth (m)	Sam- pling depth (m)	Tow- ing time (min)	Bot- tom sal (ppt)	Bot- tom temp (°C)	Chaetognath specimens per sample																
									Ec	El	Ep	Ebp	Eba	Cm	Ms	Md	Mm	Sm	Sp	Ks	Fh	Fl	Sb	Pd	Ss
Area 1	29°02'N 88°27'W	8/2/87	0941	677	200-500	55	36.0	8.4	-	-	-	-	-	-	>50	-	>10	>10	>10	>10	>50	-	<10	<10	
			2007	494	200-400*	33	36.0	8.4	3	-	-	-	-	-	-	-	-	-	<10	<10	6	-	-	1	
			1715	677	200-500	82	38.0	6.5	-	-	1	-	1	33	11	9	-	-	11	12	6	-	-	+	
			0909	494	200-400	55	37.0	8.0	-	-	-	-	-	+	+	+	1	+	+	+	+	-	-	-	
			1147	677	200-500	75	36.0	6.5	-	-	-	-	-	2	1	2	-	-	6	2	1	-	13	9	
Area 2	29°18'N 87°34'W	8/4/87	1930	677	677**	25hr	36.0	6.5	2	-	1	-	4	4	4	4	6	-	-	6	2	1	-		
			1640	677	200-500	54	38.0	8.6	-	-	3	-	-	>50	<10	<10	-	>50	>50	>10	>10	<10	-	-	
			1910	494	200-400*	44	38.0	8.6	131	-	-	-	-	>50	1	-	-	18	25	7	-	-	1	-	
			1012	677	200-500	53	36.0	6.2	-	-	9	-	-	50	>25	>30	-	1	73	12	18	-	-	8	
			1035	677	200-500	30	34.0	6.3	5	-	-	-	-	23	10	-	5	1	11	-	7	-	1	3	
Area 3	29°21'N 86°57'W	8/6/87	2002	494	200-400	58	35.0	8.8	-	-	-	-	-	-	1	-	2	-	2	2	2	-	3	2	
			0730	677	677**	23hr	34.0	6.3	5	-	2	-	-	5	2	8	-	-	4	2	8	-	4	-	
			0838	677	200-500	54	39.0	6.4	13	2	-	3	-	>50	7	>10	-	>50	<10	>50	>50	-	-	<10	
			1710	677	200-500	55	38.0	8.0	-	-	-	-	-	>100	<10	>25	-	-	>100	44	4	-	-	5	
			1317	494	200-400	58	36.0	7.7	-	-	3	-	2	-	34	+	+	-	+	+	+	-	-	+	
Area 4	27°54'N 85°16'W	8/8/87	1919	677	200-500	94	36.0	6.7	2	3	-	10	-	3	10	6	2	-	1	3	1	4	-	5	
			1840	677	677**	25hr	36.0	6.7	7	-	2	-	-	5	2	>10	-	-	4	2	8	-	4	>10	
			1150	494	200-400	31	38.0	7.7	1	-	-	-	-	35	1	6	-	-	23	7	16	-	2	2	
			1533	677	200-500	44	38.0	7.7	-	-	-	-	-	>50	<10	<10	-	-	>10	>50	-	-	<10		
			0012	677	200-500	36	37.0	9.4	-	3	-	9	-	51	43	20	-	1	20	12	25	-	-	-	
Area 5	27°00'N 84°57'W	8/10/87	0915	677	200-500	82	38.0	6.5	-	-	1	-	-	-	8	2	-	-	3	2	4	-	-	2	
			1432	494	200-400	46	38.0	8.4	-	-	-	-	-	+	+	-	-	-	+	+	+	-	-	+	
			2219	494	200-400	41	38.0	8.4	-	-	-	-	-	+	+	-	-	-	+	+	+	-	-	+	
			2345	494	400-485	27	38.0	8.4	1	-	1	-	-	1	+	+	-	-	1	+	+	+	-	1	6
			2726	677	677**	24hr	38.0	6.5	3	-	-	-	-	1	-	5	-	-	6	1	-	1	6	3	
Area 5	27°00'N 84°57'W	8/10/87	1609	494	200-400	34	38.0	8.6	-	-	-	-	-	-	<10	<10	>50	-	>50	>10	-	-	2	1	
			2146	677	200-500	45	38.0	6.4	-	-	4	-	-	38	3	7	-	-	16	9	39	-	-	-	
			1633	677	200-500	102	37.0	6.8	-	-	2	-	-	67	44	14	-	1	99	12	22	-	-	-	
			1649	677	200-500	73	38.0	6.6	-	-	-	-	-	8	-	-	-	-	1	2	3	-	-	3	
			2724	677	677**	24hr	38.0	6.6	-	4	1	-	1	3	2	2	1	-	-	2	1	-	-	3	9
Area 5	27°00'N 84°57'W	8/20/88	0017	494	200-400	-	NT	NT	-	-	-	-	-	+	+	-	-	1	+	+	+	+	+	+	
			0212	677	200-500	-	NT	NT	-	-	-	-	-	+	-	-	-	-	1	+	+	+	+	+	+

* net accidentally dragged bottom

** 0.3 m nets attached to crab traps, passive samples

NT = not taken

+ = present but not counted

Ec = *Eutrochira calliops*El = *Eutrochira jowleri*Ep = *Eutrochira proboscidea*Ebp = *Eutrochira bathypelagica*Eba = *Eutrochira bathypelagica*Cm = *Caecosagitta macrocephala*MS = *Mesosagitta sibogae*Md = *Mesosagitta decipiens*Mm = *Mesosagitta minima*Sm = *Sagitta megalophthalma*Sp = *Solidosagitta planicornis*Ks = *Krohnitta subtilis*Fh = *Flaccisagitta hexaptera*Fl = *Flaccisagitta lyra*Sb = *Sagitta bipunctata*Pd = *Pterosagitta draco*Ss = *Serratosagitta serratodentata*

with the latter being the most common (24 samples). Their presence in the samples probably indicated either mixing of epipelagic water into the upper reaches of the sampled strata (200–500 m) or contamination of samples with material from upper waters. The bottom nets, which were continuously open, naturally captured a few specimens of epipelagic fauna during deployment and retrieval.

Four of the species obtained in this study, *Eukrohnia calliops*, *E. proboscidea*, *Mesosagitta sibogae*, and *Sagitta megalophthalma*, constitute new records for the Gulf of Mexico. The following list displays synonyms and selected descriptive references for the 14 deep-water and three epipelagic species found in the samples. See McLelland (1989b) for distribution records, ecological notes, meristic counts, and brief descriptions of these and other species occurring in the Gulf of Mexico.

EUKROHNIA CALLIOPS McLelland

- E. calliops* McLelland, 1989a (Figs. 2, 3, 4A, 5A,B)
E. calliops, McLelland 1989b (Figs. 2A–D).

EUKROHNIA FOWLERI Ritter-Zahony

- E. fowleri* Ritter-Zahony, 1909.
E. fowleri, Ritter-Zahony 1911a (Figs. 43,45); David 1958 (Figs. 2b, 3a,d); Colman 1959; Alvario 1962 (Figs. 19b,e; 21c,d), 1967 (Figs. 3,4), 1969 (Figs. 36,37); Ducret 1965 (Figs. 3c, 4d, 5–7); Furnestn 1965 (Figs. 4–6); Every 1968 (Pl. 2); Fagetti 1968; Silas and Srinivasan 1968 (Fig. 7G–K); Boltovskoy 1981 (Fig. 256/3); Kassatkina 1982 (Fig. 38B,C); Michel 1984 (Fig. 11); McLelland 1989a (Figs. 4D; 5G,H), 1989b (Figs. 3A–F).

EUKROHNIA PROBOSCIDEA Furnestn and Ducret

- E. proboscidea* Furnestn and Ducret, 1965 (Fig. 1).
E. proboscidea, Ducret 1965 (Figs. 3d, 4c, 9–12), 1975 (Pl. 4B); Owre 1973; Michel 1984 (Figs. 13–15); Casanova 1986; McLelland 1989a (Figs. 4C; 5E,F), 1989b (Figs. 2E–G).

EUKROHNIA BATHYPELAGICA Alvario

- E. bathypelagica* Alvario, 1962 (Figs. 18; 19c,d,f,g; 20)
E. bathypelagica, Alvario 1967 (Figs. 1,2), 1969 (Figs. 34,35); Ducret 1965 (Figs. 3b, 4b, 8); Silas and Srinivasan 1968 (Figs. 1M, 2E–H); Owre 1973; Boltovskoy 1981 (Fig. 256/2); Kassatkina 1982 (Fig. 35); Michel 1984 (Fig. 10); Casanova 1986 (Fig. 4d,e); McLelland 1989b.

EUKROHNIA BATHYANTARCTICA David

- E. bathyantartica* David, 1958 (Figs. 2a, 3b,c)
E. bathyantartica, Fagetti 1968 (Fig. 1); Alvario 1969 (Figs. 32,33); Owre 1972, 1973 (Fig. 3); Boltovskoy 1981 (Fig. 256/1); Michel 1984 (Fig. 9); McLelland 1989b.

CAECOSAGITTA MACROCEPHALA (Fowler) Tokioka

- Sagitta macrocephala* Fowler, 1905
S. macrocephala, Ritter-Zahony 1911a (Figs. 37,38); Colman 1959; Alvario 1967 (Figs. 28,29), 1969 (Figs. 75,76); Every 1968 (Pl. 7B); Boltovskoy 1981 (Fig. 256/15); Michel 1984 (Figs. 28,29).
C. macrocephala, Tokioka 1965; Kassatkina 1982 (Fig. 70A–C); McLelland 1989b (Figs. 6A–B).

MESOSAGITTA SIBOGAE (Fowler) Tokioka

- Sagitta sibogae* Fowler, 1906 (Pl. 2, Figs. 66–72).
S. sibogae, Pierrot-Bults 1979 (Figs. 1b, 5,6)
S. decipiens, Alvario 1967 (Figs. 38,39), 1969 (Figs. 87,88);
M. sibogae, McLelland 1989b (Figs. 8B,C; 12F).

MESOSAGITTA DECIPIENS (Fowler) Tokioka

- Sagitta decipiens* Fowler, 1905 (Pl. 5, Figs. 32–35)
S. decipiens, Pierrot-Bults 1979 (Figs. 1a, 2–4); Boltovskoy 1981 (Fig. 256/8a); Michel 1984 (Fig. 19)
M. decipiens, Tokioka 1965; McLelland 1989b (Figs. 8A, 12E).

MESOSAGITTA MINIMA (Grassi) Tokioka

- Sagitta minima* Grassi, 1881
S. minima, Ritter-Zahony 1911a (Figs. 27–29); Almeida-Prado 1961 (Figs. 10,12,14,15); Alvario 1967 (Figs. 37,37), 1969 (Figs. 85,86); Every 1968 (Pl. 8); Boltovskoy 1981 (Fig. 256/18); Michel 1984 (Fig. 34).
M. minima, Tokioka 1965; Kotori and Kobayashi 1979 (Figs. 5A,B); Kassatkina 1982 (Fig. 55); McLelland 1989b (Figs. 8D, 12D).

SAGITTA MEGALOPHTHALMA Dallot and Ducret

- S. megalophthalma* Dallot and Ducret, 1969 (Figs. 1,2).
S. megalophthalma, Dallot 1970 (Figs. 5d, 7a); Michel 1984 (Figs. 30–33); McLelland 1989b (Figs. 10A–C).

SOLIDOSAGITTA PLANCTONIS (Steinhaus) Tokioka*Sagitta planctonis* Steinhaus, 1896*S. zetesios* Fowler, 1905*S. zetesios*, Colman 1959; Alvaríño 1967 (Figs. 30,31), 1969 (Figs. 81,82); Dallot 1970 (Figs. 1-3, 5a, 7f); Boltovskoy 1981 (Fig. 256/23).*S. planctonis* forma *zetesios*, Pierrot-Bults 1975; Michel 1984 (Figs. 3,36).*Solidosagitta zetesios*, Tokioka 1965; Kassatkina 1982 (Fig. 57)*S. planctonis*, McLelland 1989b (Figs. 10D-F).**KROHNITTA SUBTILIS** (Grassi) Ritter-Zahony*Sagitta subtilis* Grassi, 1881*K. subtilis*, Ritter-Zahony 1911a (Figs. 49-51); Vannucci and Hosoe 1952 (PL. 3, figs. 5,6; PL. 4, figs. 7,8); Suárez-Caabro 1955 (Pl. 7, Figs. A-E); Suárez-Caabro and Madruga 1960 (Fig. 3B); Colman 1959; Vega-Rodriguez 1965 (Fig. 8); Alvaríño 1967 (Figs. 9,10), 1969 (Figs. 42,43); Every 1968 (Pl. 1A); Boltovskoy 1981 (Fig. 256/6); Michel 1984 (Figs. 4,41); McLelland 1989b (Figs. 5A-D).**FLACCISAGITTA HEXAPTERA** (d'Orbigny) Tokioka*Sagitta hexaptera* d'Orbigny, 1843 (Figs. 4,5)*S. hexaptera*, Ritter-Zahony 1911a (Fig. 1), 1911b (Figs. 6,7); Vannucci and Hosoe 1952 (PL. 1, fig.4; PL. 2, figs. 2-4); Suárez-Caabro 1955 (Pl. 1, Figs. A-E); Colman 1959; Vega-Rodriguez 1965 (Figs. 3A,B); Alvaríño 1967 (Figs. 15,16), 1969 (Figs. 54,55); Every 1968 (Pl. 5); Boltovskoy 1981 (Fig. 256/12); Michel 1984 (Fig. 25).*Flaccisagitta hexaptera*, Tokioka 1965; Kassatkina 1982 (Fig. 91); Thuesen and Bieri 1987 (Figs. 1-9); McLelland 1989b (Figs. 7B,C; 12A).**FLACCISAGITTA LYRA** (Krohn) Tokioka*Sagitta lyra* Krohn, 1853*S. lyra*, Ritter-Zahony 1911a (Figs. 3,8), 1911b (Fig. 8); Colman 1959; Alvaríño 1967 (Figs. 13,14), 1969 (Figs. 50,5); Every 1968 (Pl. 3A); Silas and Srinivasan 1968 (Fig. 7A-F); Boltovskoy 1981 (Fig. 256/14); Michel 1984 (Fig. 27).*Flaccisagitta lyra*, Tokioka 1965; Kassatkina 1982 (Fig. 91); McLelland 1989b (Figs. 7D,E; 12B).**PTEROSAGITTA DRACO** (Krohn) Costa*Sagitta draco* Krohn, 1853*P. mediterranea*, Costa 1869*Spadella draco*, Fowler 1906, Michael 1911 (PL. 2, fig. 10; PL. 3, fig. 23; PL. 4, fig. 37).*P. besnardi*, Vannucci and Hosoe 1952 (PL. 4, figs. 1-5).*P. draco*, Ritter-Zahony 1911a (Fig. 40), 1911b (Fig. 15); Suárez-Caabro 1955 (Pl. 9, Figs. A-F); Colman 1959; Suárez-Caabro and Madruga 1960 (Fig. 3D); Vega-Rodriguez 1965 (Fig. 10); Alvaríño 1967 (Figs. 11,12), 1969 (Figs. 44,45); Boltovskoy 1981 (Fig. 252g); Kassatkina 1982 (Fig. 39); Michel 1984 (Fig. 5); McLelland 1989b (Figs. 4, 12H).**SAGITTA BIPUNCTATA** Quoy and Gaimard*S. bipunctata* Quoy and Gaimard, 1827 (PL. 8C, figs. 2-6).*S. bipunctata*, Ritter-Zahony 1911a (Fig. 15), 1911b (Fig. 11); Vannucci and Hosoe 1952 (PL. 1, figs. 1-3; PL. 2, fig. 1); Suárez-Caabro 1955 (Pl. 3, Figs. A-E); Colman 1959; Vega-Rodriguez 1965 (Figs. 5A,B); Alvaríño 1969 (Figs. 71,72); Kassatkina 1982 (Fig. 84); Boltovskoy 1981 (Figs. 256/7a,b); Michel 1984 (Fig. 18); McLelland 1989b (Figs. 9, 12I).**SERRATOSAGITTA SERRATODENTATA**
(Krohn) Tokioka*Sagitta serrato-dentata* Krohn, 1853 (Figs. 3,4)*S. serratodentata*, Ritter-Zahony 1911a (Figs. 21,22), 1911b (Fig. 13); Vannucci and Hosoe 1952 (PL. 3, figs. 1-5); Suárez-Caabro 1955 (Pl. 4, Figs. A-E); Colman 1959; Suárez-Caabro and Madruga 1960 (Fig. 2C); Vega-Rodriguez 1965 (Figs. 6A-C); Alvaríño 1967, 1969 (Figs. 61,62); Boltovskoy 1981 (Fig. 256/20a-c); Michel 1984 (Figs. 37,38).*S. serratodentata* subspecies *serratodentata*, Pierrot-Bults 1974 (Fig. 3).*Serratosagitta serratodentata*, Tokioka 1965; McLelland 1989b (Figs. 11A-D).

Considering worldwide and Atlantic distribution synopses published by Alvaríño (1965, 1969) and others, the species of Chaetognatha occurring in Gulf of Mexico waters as listed by McLelland (1989b) can be loosely grouped into depth categories which may vary according to location, water conditions, time of day, maturity stage, etc. They are arranged below within such categories in order of increasing vertical distribution:

Epiplanktonic (0-200 m)*Sagitta tenuis**Sagitta friderici**Sagitta helenae**Ferosagitta hispida*

Flaccisagitta enflata
Krohnitta pacifica
Serratosagitta serratodentata
Pterosagitta draco
Sagitta bipunctata

Eukrohnia hamata
Eukrohnia bathyantarctica
Bathylabos typhlops

Lower epiplanktonic - Upper mesoplanktonic

Flaccisagitta hexaptera
Mesosagitta minima
Krohnitta subtilis

Mesoplanktonic (200-1000 m)

Flaccisagitta lyra
Mesosagitta sibogae
Mesosagitta decipiens
Sagitta megalophthalma
Solidosagitta planctonis

Lower mesoplanktonic - bathyplanktonic (below 1000 m)

Eukrohnia calliops
Eukrohnia fowleri
Eukrohnia proboscidea
Eukrohnia bathypelagica
Caecosagitta macrocephala

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Acanthohaustorius uncinus, a New Species of Sand-Burrowing Amphipod from the Northern Gulf of Mexico, with Notes on its Ecology (Haustoriidae: Haustoriinae)

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ACANTHOHAUSTORIUS UNCINUS, A NEW SPECIES OF SAND-BURROWING AMPHIPOD FROM THE NORTHERN GULF OF MEXICO, WITH NOTES ON ITS ECOLOGY (HAUSTORIIDAE: HAUSTORIINAE)

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ABSTRACT A new species of sand-burrowing amphipod, *Acanthohaustorius uncinus*, is described from vegetated and unvegetated estuarine sands from St. Andrew Bay, Florida and East Ship Island, Mississippi. The genus *Acanthohaustorius* has been informally recorded from St. Andrew Bay, but this species is now formally described from the Gulf of Mexico. *A. uncinus* n. sp. is most similar to *A. millsii* of the open American Atlantic coast. It differs from *A. millsii* in the presence of a dorsally directed, hooked spine on the peduncle of uropod 1 and the totally cleft telson lobes. Information on the ecology of *A. uncinus* n. sp. in St. Andrew Bay is provided, along with a revised key to the known species of *Acanthohaustorius* and a brief review of haustoriid studies in the Gulf of Mexico.

INTRODUCTION

The sand-burrowing amphipods of the family Haustoriidae Stebbing, 1906 comprise one of the dominant macroinfaunal components of the sandy inlets and beaches of the Gulf of Mexico and the Atlantic coasts of the United States and Canada (Bousfield 1970). The subfamily Haustoriinae Bousfield, 1965 comprises six genera of amphipods variously adapted to high energy environments in marine and estuarine sediments. The distribution of the subfamily and the ecology of several species have been treated by Croker (1967), Dexter (1967), Sameoto (1969), Bousfield (1965, 1970), Shelton and Robertson (1981), and Thomas and Barnard (1984).

In contrast to the Atlantic coast, studies have been limited of haustoriid amphipods in the Gulf of Mexico. Initially, Pearse (1908) described *Haustorius americanus* from Louisiana. Bousfield (1965) reexamined Pearse's material and placed the amphipod in the newly created genus *Pseudohaustorius* and separated it from *P. carolinensis* Bousfield, 1965 by its lack of a terminal segment on the outer ramus of uropod 3. Pearse (1912) also reported *Haustorius arenarius* Slabber from the Albatross expeditions of 1885 off Pensacola, Florida. Croker (1967) considered early records of *H. arenarius* erroneous identifications. Until Pearse's material is reexamined, this record from the Gulf remains dubious. No new Gulf species were documented until *Protohaustorius bousfieldi* and *Para-haustorius obliquus* from Texas beaches were described by Robertson and Shelton (1978). The study of beach

fauna which revealed the new species also produced undescribed species of *Lepidactylus* and *Acanthohaustorius* (Shelton and Robertson 1981). The complex problem of *Lepidactylus* in the Gulf of Mexico has been partially related to the unclear distinction between it and *Haustorius*. Robertson and Shelton (1980) clarified some of these relationships and described a new species, *Lepidactylus triarticulatus*, from intertidal, fine-grained sand beaches from Padre Island, Texas to Grand Isle, Louisiana. *L. triarticulatus* was compared to a second undescribed species of *Lepidactylus* known from Little Deer Island, Mississippi that possibly ranges into western Florida (E.L. Bousfield, per. comm.).

The exact number of undescribed haustoriids from the Gulf of Mexico is unclear. A comprehensive examination of material recovered in ecological surveys around the Gulf is needed in order to assess the representation of the family, specifically the subfamily Haustoriinae.

The genus *Acanthohaustorius* has not been formally treated from the Gulf of Mexico. This genus is endemic to North America, as are all the representatives of Haustoriinae, except *Haustorius*, and contains seven species from the Atlantic coast from Canada to the Florida Keys: *A. spinosus* (Bousfield 1962); *A. millsii* Bousfield, 1965; *A. intermedius* Bousfield, 1965; *A. shoemakeri* Bousfield, 1965; *A. bousfieldi* and *A. similis* Frame, 1980; and *A. pansus* Thomas and Barnard, 1984. Among these species, reported habitats range from fine sediments in sheltered inshore waters to coarse sand and shell bottoms in offshore waters at

depths as great as 40 meters (Dexter 1967, Frame 1980, Thomas and Barnard 1984).

Recent ecological and environmental monitoring studies in St. Andrew Bay, Florida, a high salinity estuary on the northern coast of the Gulf of Mexico, have revealed the presence of several undescribed species of *Acanthohaustorius*. Saloman (1976) reported an unknown species of *Acanthohaustorius* from almost pure quartz sand in waters of 3 to 10 meters in a study of the sediments and fauna of the surf zone and nearshore vicinity along the Gulf beaches outside St. Andrew Bay. Saloman et al. (1982) found a different *Acanthohaustorius* sp. to be the most widespread haustoriid within St. Andrew Bay. This study, directed toward benthic faunal assemblages from vegetated and unvegetated habitats, revealed the presence of the unknown species in 31 of the 89 unvegetated sand stations and from 7 of the 60 stations vegetated with a mixture of *Halodule* and *Thalassia* which were examined along the shallow, subtidal bayshore. Sediments varied from fine to medium sand. Taylor (1987) reported two unknown species of *Acanthohaustorius* from similar habitats to a depth of 4.6 meters. The numerically dominant form, referred to as *Acanthohaustorius* sp. A. by Taylor (1987), is presumably the *Acanthohaustorius* sp. of Saloman et al. (1982) and has affinities with *A. millsi*. The less numerous form, *Acanthohaustorius* sp. B., of Taylor (1987) is similar to *A. intermedius* (Richard Heard, per. comm.). Materials examined from East Ship Island, Mississippi conform to sp. A. of Taylor (1987) in morphology and habitat.

MATERIALS AND METHODS

Sediment samples were obtained with a hand-held coring device of 1/64 sq. meter which penetrated the sediment to a depth of 23 cm. Sediment samples were washed in the field through a 0.5 mm mesh screen and the retained material was fixed in 10% formalin. In the laboratory, samples were washed in tap water through a 0.5 mm mesh screen. Amphipods were removed from the retained materials and preserved in 70% isopropyl alcohol. Materials examined from Taylor (1987) were collected and fixed in the same manner, except that they were stained with Rose Bengal. Dissections were performed under a Wild M-5 stereoscope. Body parts of the paratypes were mounted in anhydrous glycerine on Cobb slides. Examinations and drawings were made with a Nikon Differential Interference Contrast microscope with a drawing tube. Hydrological and sediment analysis from the type locality are available in Saloman et al. (1982) and Taylor (1987).

RESULTS

Haustoriidae Stebbing, 1906

Haustoriinae Bousfield, 1965

Acanthohaustorius uncinus new sp.

Plates I-III

Materials examined

Holotype – Female "f", National Museum of Natural History, USNM 235055, 5.0 mm; St. Andrew Bay, Florida, 30°19'25" N, 85°42'52" W, unvegetated fine to medium sand and shell, depth 2.0 meters, J.L. Taylor, collector.

Paratypes – 1 female "a", 4.7 mm, USNM 235185; 1 male "b", 4.5 mm, USNM 235186, St. Andrew Bay, Florida, 30°19'50" N, 85°41'50" W, fine sand, 21 January 1984. 1 male *allotype* "c", 4.0 mm, USNM 235187, St. Andrew Bay, Florida, 30°17'15" N, 85°41'19" W, subtidal fine to medium sand, 21 November 1987, J.M. Foster, collector. 3 females "d", 5.0 mm, USNM 235188; "e" 5.0 mm, USNM 235189; 3 males "g", 4.5 mm, USNM 235190; "h", 4.5 mm, USNM 235191; "i" 4.3 mm, USNM 235192; St. Andrew Bay, Florida, 30°19'25" N, 85°42'52" W, unvegetated fine to medium sand and shell, depth 2.0 meters, J.L. Taylor, collector. 1 male "j" 5.0 mm, USNM 235193; 1 female "k" 5.0 mm, USNM 235194; 1 juvenile "m" 2.0 mm, USNM 235196; St. Andrew Bay, Florida, 30°04'17" N, 85°38'48" W, fine to medium sand with quartzite gravel, depth 0.5 meters, 3 January 1987, J.M. Foster, collector. 1 male "l" 4.5 mm, USNM 235195, East Ship Island, Mississippi, dredge in medium sand, depth 3.0 to 4.0 meters, 23 June 1987, R.W. Heard, collector.

Diagnosis

Maxilla 1, inner plate with 6 sparsely plumose setae, outer 3 minutely pectinate; article 5, pereopod 6 with horizontal ventral margin armed with 6 spines, posterior margin with 3 spines; article 6 posterior margin with 3 spine groups; coxa 7 acute posteriorly; uropod 1 peduncle with 3-5 dorsolateral spines, naked ventrally, 1 interramal spine and 1 large dorsally directed, hooked spine distally, inner ramus subequal to outer; telson lobes with slight concavity distolaterally, each lobe with 1 plumose seta; lobes completely cleft, appearing to be separate.

Description

Paratype – Female "a" 4.7 mm. Body broad, barrel-shaped. Head broader than long; rostrum blunt, sub-

conical, wide at base. Eyes translucent white in life, not apparent in preserved material.

Antenna 1 – Article 1 longer than deep; oblique row of 3 plumose setae from midline of article 1 to anteroventral margin, lateral margin with 7 pilose spines; article 2, 0.73 times width of article 1, article 2, 1.1 times length of article 1; flagellum 5 segmented; accessory flagellum with 2 subequal segments.

Antenna 2 – Article 3 with 2 short, simple setae and 1 long plume posteriorly; article 4 long, with broad posterior lobe, posterolateral margin with 9 elongate, finely pilose spines, posterior margin with numerous elongate plumose setae, sparse simple and pilose spines on dorsal and lateral margins; article 5 expanded distally with 1 distomedial pilose spine; flagellum 5 segmented, article 1 longest, setae inserted distally in articles.

Lower lip – Inner lobes broadest distally, outer lobes round, both pilose marginally; outer lobes with 5 short, stout spines on inner medial surface near distal margin.

Upper lip – Broad, apex bare.

Mandible – Incisor bifid, lacinia mobilis short, broad at base, raker row of 5 terminally serrate, spatulate blades, molar triturative, palp article 2 with 4 simple setae; palp article 3 with 12 spines in comb row; apical spines 11, distally narrowed and minutely pectinate; left mandible without lacinia mobilis, 5 blades in raker row and 1 short spine lateral to raker row.

Maxilla 1 – Inner plate with 3 medial, sparsely plumose setae and 3 medial, minutely pectinate spines; outer plate with 13 apical spines, 3 of which are blunt, translucent blades; palp 2 segmented with marginal and apical plumose setae; inner and outer plates finely pilose.

Maxilla 2 – Inner plate slender, with medial row of marginal plumose setae, aboral surface with facial row of plumose setae; outer plate expanded distally, forming an oblique lateral lobe, lateral margins finely pilose, inner medial margin bearing long, widely-spaced plumose setae, aboral lateral margin with 13 pectinate spines.

Maxilliped – Inner plate with medial, simple setae along inner margin, apical margin with 2 blunt spines, 6 long, acute spines, and 2 short, penicillate setae; outer plate broader than inner; subacute inner margin with 11 blunt spines, subacute lateral margin with several rows of simple setae; palp article 2 produced distally to near transverse outer margin of article 3, several rows of long setae on inner distal margin and two strong distal setae on outer lateral margin; palp article 3 geniculate, with elongate, simple setae marginally and with pectinate terminal setae.

Coxae 1-4 – Ventral margins forming a gentle,

dorsally directed curve posteriorly; coxae contiguous, progressively longer and broader posteriorly.

Gnathopod 1 – Coxa deeper than wide, slightly excavate posteriorly, 3 plumose setae on posterior margin, 3 elongate plumose setae and 1 short simple seta on posteroventral margin, 3 simple setae on anterodistal margin; article 2 elongate with 6 posterior marginal setae; article 5 expanded posteriorly with dense clusters of setae on posterior margin; article 6, anterodistal margin with 4 dense clusters of setae each with recurved tips and a single accessory setule; dactyl with strongly projecting nail.

Gnathopod 2 – Chelate; coxa similar in shape to coxa 1, but slightly longer; posterior margin with 5 plumose setae, posteroventral margin with 3 plumes and 1 short, simple seta; article 2 elongate, posterior margin with 7 evenly spaced, very long, simple setae, posterodistal margin with a cluster of 7 long, simple setae; article 5, ventral margin with about 12 marginal setae and 4 groups of 5-5-3-1 spatulate, marginally pectinate spines on the distal half of the posterior margin; article 6 elongate, posteroventral margin with 5 long, distally tapered, toothed spines; anterodistal margin with 5 transverse rows of long, club-tipped setae and elongate, finely toothed spines.

Pereopod 3 – Coxa scythe-shaped, posterior margin with 8 plumose setae, posteroventral margin with 1 very long, glassy spine, 1 setule on anterodistal margin; article 2 elongate, posterior margin with 3 plumed setae distally; article 4, anterior margin with 7 plumed setae, posterior margin densely setose, 5 long plumes on posterodistal margin; article 5, clusters of 4 setae at anterodistal margin, 11 spines, some with accessory setules, and 3 plumes arranged around a posteriorly directed circular cusp; article 6 with 10 spines, some with accessory setules, and 5 plumes arranged around an ovate cusp.

Pereopod 4 – Coxa broad, posterior margin slightly excavate, 2 ventral setae; article 2 elongate, 2 setae and 1 plume on posterodistal margin; article 4, 7 plumes on anterior margin, anterodistal margin with slender seta and 2 curved, pectinate spines, posterior margin with 4 spines and 4 plumose setae, posterodistal margin with an oblique row of 4 plumed setae inserted lateral to margin; article 5 expanded distally, 1 slender spine and 2 recurved pectinate spines anterodistally, 7 spines and 4 plumes arranged around a posteriorly directed cusp, some with accessory setules; article 6 with 10 spines and 3 plumes surrounding a shallow, ovate cusp, 1 slender penicillate seta terminally.

Pereopod 5 – Coxa much broader than deep, bilobed ventrally; 2 setae on posterior margin; article 2 slightly expanded posteriorly, posterior margin with 6 setae;

anterior margin with 14 plumed setae and 2 slender spines; article 4 width-depth subequal, posterior margin expanded, 6 anterior marginal spines, each with an adjacent plumed seta, anterodistal margin with 1 long and 2 short spines, 2 groups of 4 and 3 spines located ventromedially, posterodistal margin with 3 spines, posterior margin spine formula 2-2-3, posterior facial spine formula 3-5; article 5, anterior margin with 2 spines and several plumes, ventral margin near anterodistal juncture with 1 short and 3 long spines and several plumed setae, 6 ventral spines near posterior margin, posterior margin with ventrally directed, bilobed expansion, lower lobe with 1 long spine and several plumes, upper lobe with a row of 3 spines lateral to margin and numerous plumose setae, anterior facial spine formula 10-6, posterior facial spines 1 lateral row of 6 spines; article 6, anterior spine formula 3-3-2, apex with 2 short and 3 long spines and 1 penicillate seta.

Pereopod 6 – Coxa small, rounded posteriorly, 2 setae on posterior margin, article 2 quadrate, deeper than wide, posteroproximal margin with 4 setae, anterior margin with dense plumed setae and 2 groups of 2 setules distally; article 4, anterior marginal spine counts 1-1-1-2-2-3-3, anteroventral margin with 3 spines, ventrolateral margin with 2 groups of 2 spines, posteroventral lobe with 3 spines, ventral margin richly plumose, posterior margin with 4 spines and numerous plumose setae, anterior facial spine formula 2-2-2, posterior facial spine formula 3-3; article 5 subquadrate, narrowed slightly at articulation with article 4; ventral margin perpendicular to sides, anterior marginal spine formula 1-2-2-4, anterodistal margin with 6 spines, ventral margin with 6 spines, posterodistal margin with 1 short and 3 long spine groups, anterior facial spine formula 2-1, medial facial spine formula 1-1; article 6, one-fourth as wide as long, posterior margin spine formula 3-2-2, apex with 10 spines and 1 penicillate seta.

Pereopod 7 – Coxa small, posterior lobe acute with 1 short setule at apex and 2 setules on posteroventral margin; article 2 large, orbicular with 15 plumose setae on proximal half of anterior margin, 7 long, distally narrowed, minutely pectinate spines on distal half, anterodistal margin with 1 short and 4 pectinate spines, posterior margin with 2 short, simple spines; article 4 produced posteroventrally, anterior margin with several plumed setae (formula 2-4-4), spine formula 1-2, anterodistal margin with 2 long spines and 1 plume, ventral margin with an anterior and posterior cluster of 3 spines inserted laterally to margins, 9 medial ventral spines, posterodistal margin with 1 long spine and 1 plume, posterior margin with 1 spine and 7 plumes; article 5, anterior marginal spine formula 3-6-7-5-2-5,

1 oblique row of 3 spines proximal to ventral margin anteriorly, ventral margin with 1 cluster of 3 medial and 2 slender setae near posterior margin, posterior margin naked, gently rounded, posterodistal margin with 2 spines, medial facial setal formula 2-2-2-2, posterior facial setal formula 1-1; article 6 anterior spine formula 1-3-4, posterior spine formula 2-4-4, apex with 8 spines and 1 penicillate seta.

Pleosome – Side plates 1 and 2 posterodistally produced, Pleosome side plate 3 with plumed lateral setae in formula 2-5-4-4 and a stout, dorsally directed, ventrodistal spine.

Pleopods – Pleopod 1, rami slender, inner ramus 12 segmented, outer ramus 13 segmented, peduncle with lateral setae, sparsely setose, retinacula 2. Pleopods 2 and 3 generally similar, pleopod 3 smaller and shorter.

Uropod 1 – Peduncle stout, length 4 times depth, outer margin with 3 short dorsolateral spines, ventral margin naked, 1 interramal spine, peduncle with large, dorsally directed hooked spine distolaterally; outer ramus slightly longer than inner, marginal spine formula 2-4, 9 apical spines situated in a terminal circlet, several bifid distally; inner ramus subequal to outer, 2 short spines and 3 singly inserted setae along margin, 7 apical spines with several bifid distally.

Uropod 2 – Rami subequal, both rami with long, terminal setae; peduncle twice as long as wide with an oblique row of simple facial setae.

Uropod 3 – Peduncle much shorter than rami, longer than wide; outer ramus longer than inner, 2 segmented, both articles with terminal setae; inner ramus 85% length of outer with a cluster of 3 medial setae, apical setae in dense cluster.

Telson – Cleft to base with lobes appearing to arise separately from dorsal surface of urosome; outer distal margin of each lobe with slight concavity, lobes with 8-10 marginal setae and 1 stout penicillate seta medially, inserted proximally from the marginal setae.

Gills – Laminar, present on pereopods 2-6.

Brood plates – Setose, plate on pereopod 2 smallest, plates on pereopod 3 and 4 large, subequal.

Allotype – Male, 4.0 mm; Generally similar to female, slight and inconsistent variability in setation and spination between male and female. Mouthparts identical with regard to mandibular blades, mandibular palp segment 2 comb spines, apical spines on outer plate of maxilla 1, spine grouping on inner plate of maxilliped. Slight variation in marginal and facial spination on pereopods 5-7; pereopod 5, article 5, anterior facial spines 9-6, posterior, 5; article 6, anterior marginal spines 2-2-4, 3 long and 2 short terminal spines, pereopod 6, article 5, anterior facial spines 2-2, posterior 1-1-2, anterior marginal spines 1-2-2, posterior 1-1-2-2; article 6, posterior marginal spines 2-4-3; pereopod 7,

article 5, anterior marginal spines 4-4-6-7, article 6, anterior marginal spines 1-2-3-3, posterior 4-4. Uropods similar, but many males have 5 dorsolateral spines on the peduncle of uropod 1.

Remarks

Individual variation in the number and location of spines and setae is common in haustoriid amphipods. Thomas and Barnard (1984) commented on the difficulty of obtaining a set of characters which would withstand the normal range of intraspecific variation. They concluded that the spine morphology of pereopods 5-7 and uropod 1, especially the peduncle, and the configuration of the telson vary only slightly and may be useful in sorting species. These characteristics, and others, were examined on the available specimens of *A. uncinus* n. sp. Some degree of variation was encountered among all the individuals examined, especially in pereopods 5-7; mouthpart armature was fairly consistent among the individuals examined. However, *A. uncinus* n. sp. displays a consistent hooked, distal spine on the peduncle of uropod 1, a single interramal spine on uropod 1, and a near totally cleft telson in both sexes. The numbers of dorsolateral spines on the peduncle of uropod 1 is important in distinguishing some species of *Acanthohaustorius*: *A. millsi* has 3-4 spines while *A. similis* has 8-10 spines. The counts for the examined *A. uncinus* n. sp. varied from 3 to 5, with males generally bearing 5. The marginal spine

formulas on the outer ramus of uropod 1 were considered as a character, but varied considerably among individuals and were discounted as useful in separating *A. uncinus* from other species in the genus. Setation on the inner ramus of uropod 1 varied from 3-6 setae and both single and double insertion was observed. Between the sexes, however, there was remarkable similarity in the armature of the mouthparts. Future work may show the value of spination on pereopods 5-7 in distinguishing *A. uncinus* n. sp. from other species, but in my observations, I was not able to separate sexes on those characters.

Ecology

Occurs in fine to medium unvegetated sands with shell fragments and in fine to medium sands with some silt among halophytes *Thalassia testudinum* and *Halodule wrightii* to an observed depth of 4.6 meters.

Distribution

Northern Gulf of Mexico, St. Andrew Bay, Florida to East Ship Island, Mississippi.

Etymology

From the Latin "*uncinus*" meaning "hooked." This is in reference to the distal hooked spine on the peduncle of uropod 1.

KEY TO THE SPECIES OF *ACANTHOHAUSTORIUS*

(from Thomas and Barnard (1984) modified for insertion of *A. uncinus* n. sp.)

1. Telson U-cleft less than one-half to base, lobes truncate, posterior margins straight, outer margins with slight concavity; pereopod 6 article 5, distal margin oblique; setae on inner ramus of uropod 2 arranged in clusters. *A. spinosus*
- Telson cleft to base or nearly so; lobes of telson posteriorly rounded; pereopod 6, distal margin of article 5 horizontal; setae on inner ramus of uropod 2 singly inserted 2
2. Telson of two widely separated and distinct lobes; pereopod 6 article 5 with 4 or fewer single facial spines, article 6 posterior margin with 1-2 clusters of spines *A. pansus*
- Telson lobes not widely separated; pereopod 6 article 5 with more than 4 facial spines, posterior margin of article 6 with 3-5 spine clusters 3
3. Coxa 3, posteroventral lobe weak; epimeron 3 posterior margin lacking tooth, no concavity . . . *A. intermedius*
- Coxa 3, posteroventral lobe strong; epimeron 3 with large tooth, posterior margin with concavity 4

4. Peduncle of uropod 1 with 5–9 short, stubby spines; coxa 7 posterior margin subacute *A. bousfieldi*
 Peduncle of uropod 1 lacking short stubby spines; coxa 7 posterior margin acute 5
5. Ventral margin of article 5 pereopod 6 with spines in 3–4 groups; uropod 1 inner ramus one-half outer ramus *A. shoemakeri*
 Ventral margin of article 5 pereopod 6 with continuous row of spines; uropod 1 rami subequal 6
6. Peduncle of uropod 1 with 1–2 ventral spines usually present; 8–10 dorsolateral spines *A. similis*
 Peduncle of uropod 1 without ventral spines; less than 8–10 dorsolateral spines 7
7. Peduncle of uropod 1 with a dorsally directed, posterodistal hooked spine; telson completely cleft to base, lobes giving the appearance of being separate *A. uncinus*
 Peduncle of uropod 1 with single straight, posteriorly directed spines; telson cleft nearly to base . . . *A. millsi*

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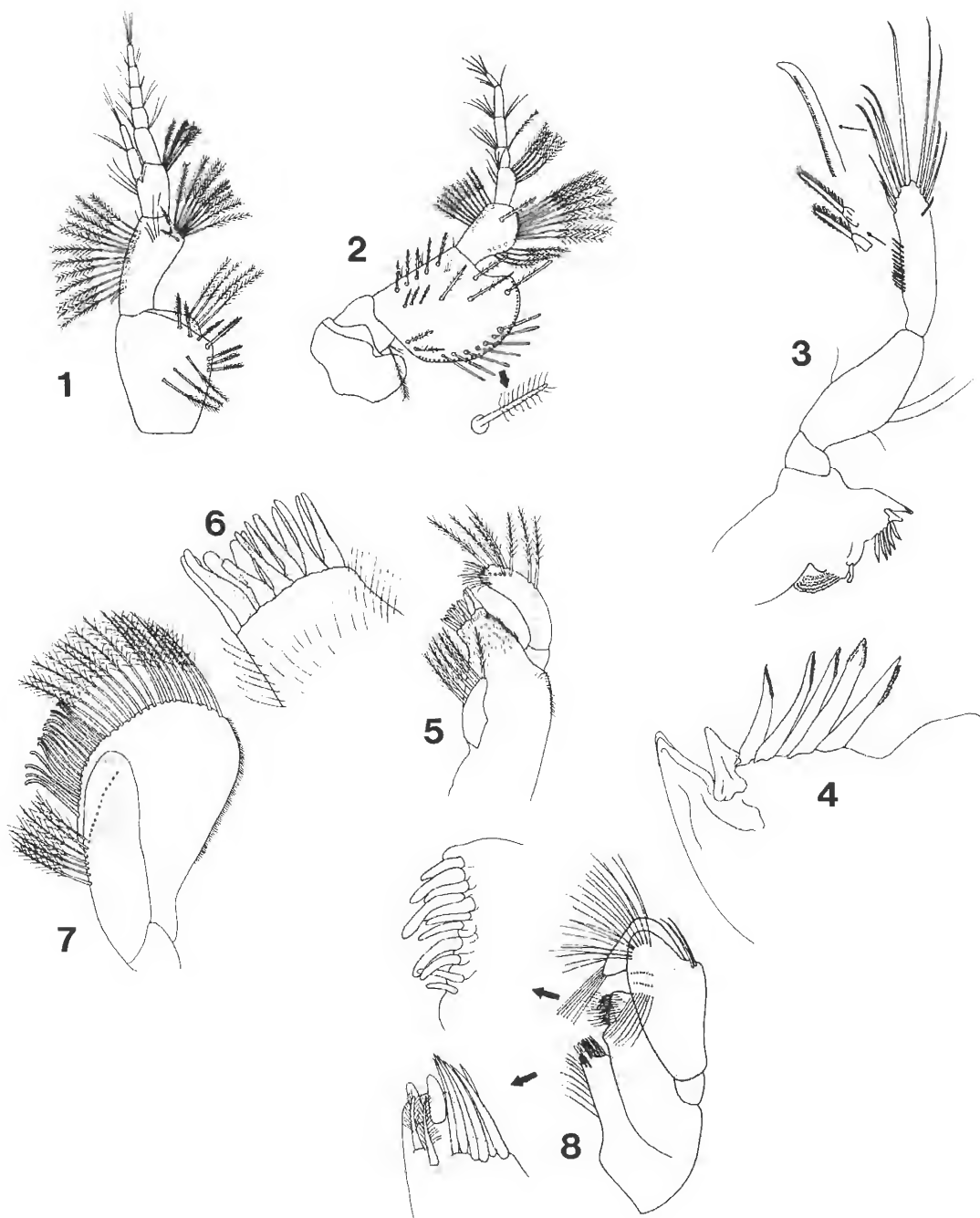


PLATE I

Acanthohaustorius uncinus n. sp. paratype female "a" 4.7 mm

Figures 1-8. (1) Antenna 1; (2) Antenna 2; (3) Mandible with detail of palp segment 3 comb spines and terminal spines; (4) Mandible, detail of incisor, lacinia mobilis, and raker row; (5) Maxilla 1; (6) Maxilla 1, outer plate; (7) Maxilla 2; (8) Maxilliped, with detail of outer and inner plates.

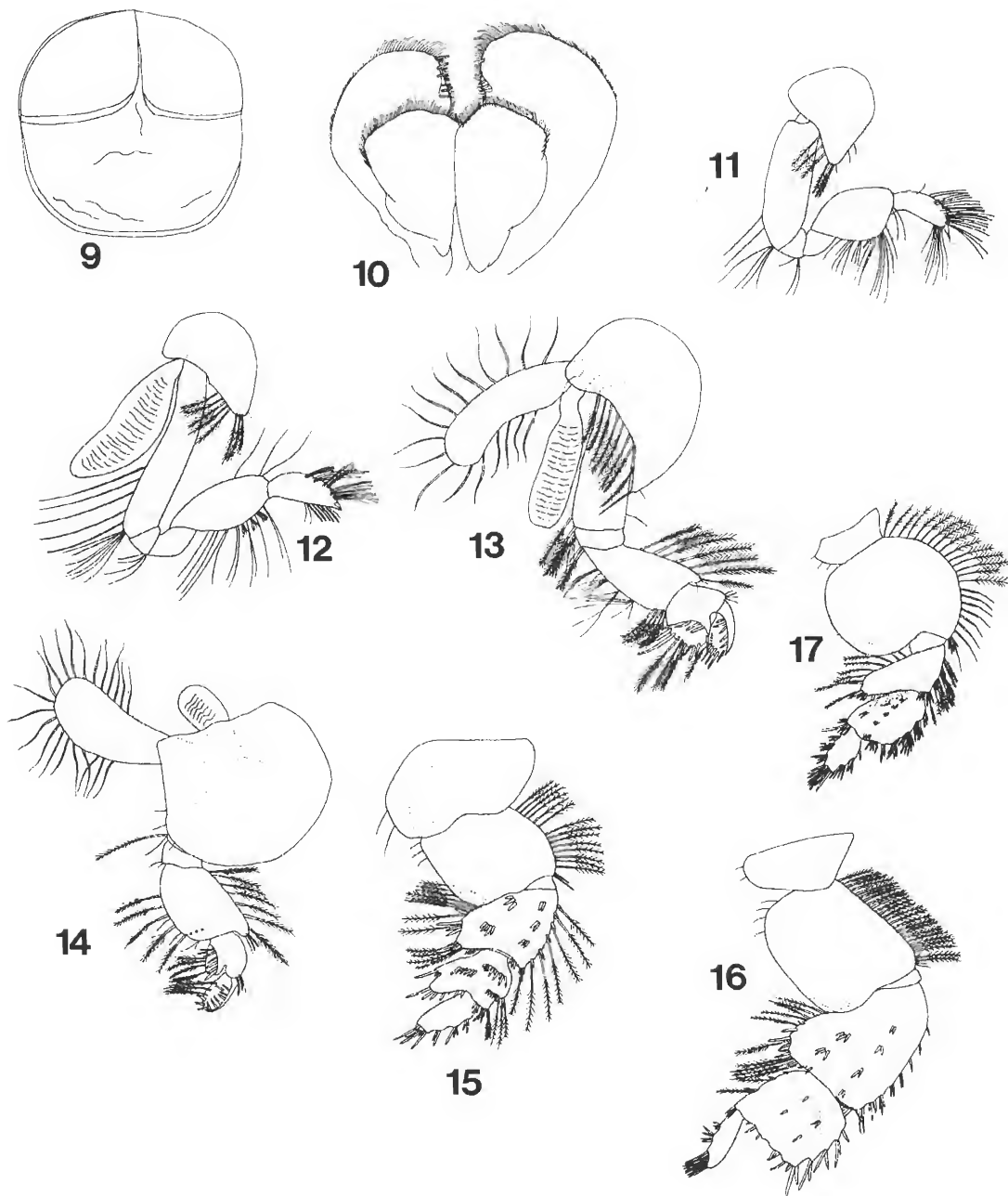


PLATE II

Acanthohaustorius uncinus n. sp. paratype female "a" 4.7 mm

Figures 9–17. (9) Upper lip, (10) Lower lip, (11) Gnathopod 1, (12) Gnathopod 2, (13) Pereopod 3, (14) Pereopod 4, (15) Pereopod 5, (16) Pereopod 6, (17) Pereopod 7.

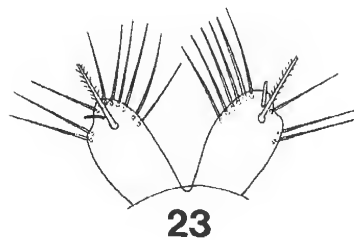
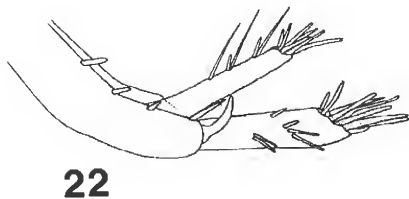
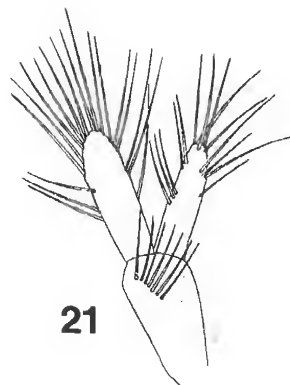
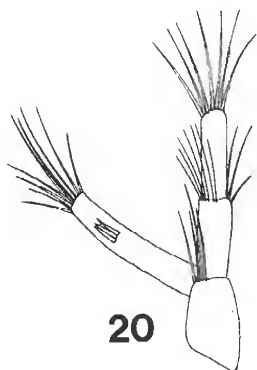
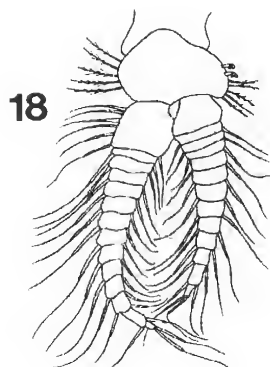


PLATE III

Acanthohaustorius uncinus n. sp. paratype female "a" 4.7 mm

Figures 18-23. (18) Pleopod 1; (19) Eplimera 3, lateral view; (20) Uropod 3; (21) Uropod 2; (22) Uropod 1; (23) Telson.

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Excorallana delaneyi, N. Sp. (Crustacea: Isopoda: Excorallanidae) from the Northeastern Gulf of Mexico, with Observations on Adult Characters and Sexual Dimorphism in Related Species of *Excorallana* Stebbing, 1904

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EXCORALLANA DELANEYI, N. SP. (CRUSTACEA: ISOPODA: EXCORALLANIDAE) FROM THE NORTHEASTERN GULF OF MEXICO, WITH OBSERVATIONS ON ADULT CHARACTERS AND SEXUAL DIMORPHISM IN RELATED SPECIES OF EXCORALLANA STEBBING, 1904

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ABSTRACT *Excorallana delaneyi* n. sp. was found associated with the sponges *Halichondria* sp. and *Hymeniacidon* sp. in St. Joseph Bay, Florida. *Excorallana delaneyi* is most similar to *E. berbicensis* Boone, 1918 described from Brazil, but it can be distinguished from that species and other members of the genus by the shape and spination of the uropods and pleotelson. A key is presented to separate *E. delaneyi* and the other seven species of *Excorallana* that lack lateral notches in the pleotelson. Morphological differences between the subadults and adults of *E. delaneyi* are described, and possible taxonomic problems resulting from such differences in other members of the genus are discussed. Based on field observations and known life history patterns for some members of the genus *Excorallana*, we consider *E. delaneyi* to be an intermittent fish parasite which lives and reproduces in a sponge domicile between feedings.

INTRODUCTION

The New World genus *Excorallana* Stebbing, 1904, is currently represented by 20 species (Lemos de Castro and Lima, 1976; Delaney, 1984). Three species, *Excorallana antillensis* (Hansen, 1890), *E. tricornis tricornis* (Hansen, 1890), and *E. mexicana* Richardson, 1905, have been reported from the Gulf of Mexico (see Richardson, 1905; Menzies and Krucynski, 1983; Delaney, 1984). During the summers of 1982-1985, specimens of a fourth undescribed species were found in the interior of sponges (*Halichondria* sp. and *Hymeniacidon* sp.) collected from a *Thalassia* grass bed habitat in St. Joseph Bay, Florida. The description of this new species is the subject of this report. Type material has been deposited in the collections of the National Museum of Natural History (USNM), Gulf Coast Research Laboratory Museum (GCRL), and Los Angeles County Museum (LACM).

Excorallana delaneyi, new species

Figures 1-8

Material examined

Holotype - 1 ovigerous female; width 3.5 mm; length 9.6 mm (USNM 240035), from *Halichondria* sp. in grassbeds at St. Joseph Bay, Florida, 29°48' N,

089°24' W, sal. 32‰, temp. 30°C, depth 0.5-1 m, coll. I. Stone and R.W. Heard, 9 July 1985.

Paratypes - 10 males, 10 females (USNM 240036), same collection data as holotype. - 10 males, 10 females (GCRL 1133), same collection data as holotype. - 5 males and 5 females (LACM 85-198.1), same collection data as holotype. 105 males (adults and juveniles), 210 females (adults and juveniles), collection of RWH, same collection data as holotype. 4 males, 7 females, collection of RWH, from *Hymeniacidon* sp. in grassbeds at State Park, St. Joseph Bay, Florida, sal. 33‰, temp. approx. 18°C, depth 0.5 m, coll. I. Stone, 20 April 1988.

Diagnosis

Cephalon with distinct anteromedial rostral point. Adult male with 3 cephalic horns; 1 directed anteriorly as continuation of rostrum; 2 placed anterolaterally above eyes, directed dorsally, anteromedial horn being a continuation of rostrum. Adult females with rudimentary pair of cephalic horns represented by 2 low tubercles above eyes. Subadult males and females lacking cephalic horns. Eyes large, distinctly separated, lateral. Frontal lamina widening anteriorly before narrowing to form subacute apex. Maxilliped with article 3 of palp elongate, length 2.5 times width. Pereonite 1 of adult male with pair of submedial tubercles near anterior margin, these tubercles lacking

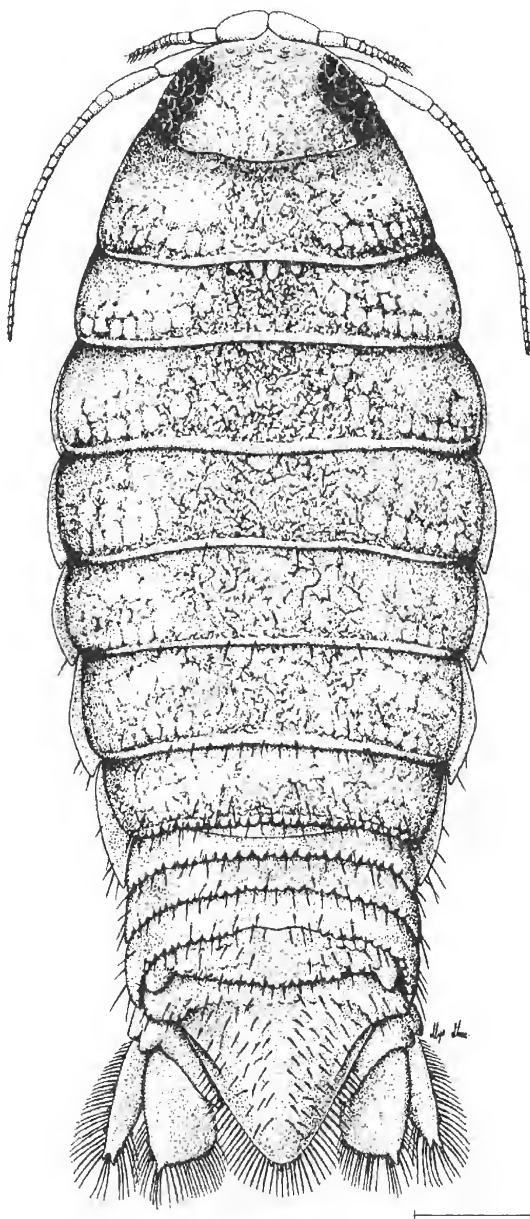


Figure 1. *Excorallana delaneyi*, n. sp. Dorsal aspect of female holotype, entire (scale = 1 mm).

on females and subadults. Pereopods 1-3 with merus and ischium having, respectively, 4 and 1 stout spines on flexor margins. Uropods extending slightly beyond pleotelson; endopods somewhat truncate with distinct posterior tooth separating 5 submedial and 2 lateral marginal spines, length nearly twice width;

exopod narrow, length nearly 3 times width, subequal to endopod, with bifurcate tip separating 2 submedial and 3 lateral marginal spines. Pleotelson triangular with lateral margins nearly straight, lacking incision or notches; 4 (rarely 6) spines present on subacute apex; bifid spinules present on dorsal, submedial surface of adults.

Description of adult female

Length 8.6-11.7 mm; width 3.2-3.6 mm. Cephalon - With 2 small, low, submedial tubercles (rudimentary horns), or indications of such, present above eyes (Fig. 6D); eyes relatively large, lateral, distinctly separated. Anterior margin of cephalon with medial rostral point (Fig. 1).

Antenna 1 (Fig. 2I) reaching posterior margin of cephalon; peduncle of 3 articles, with broad basis having distinct anterior ridge; flagellum consisting of 8 to 12 articles with esthetes along medial margin.

Antenna 2 (Fig. 2H) extending beyond posterolateral margin of pereonite 2; peduncle with 5 articles; flagellum with 17-26 articles, each with relatively short, simple setae along distolateral margin; fewer present along medial margin.

Frontal lamina visible, distinct, widening anteriorly before narrowing to subacute apex (Figs. 2E, 5). Clypeus and labrum may be partly obscured by mandibles (Fig. 2D).

Mandibles each with elongate curved incisor, possessing 2 subapical cusps (Figs. 2F, 2G); molar process apparently absent; left mandible with lacinia mobilis represented by small lobe ending in 2 long and 2 short spines; right mandible with lacinia mobilis represented by 2, or occasionally 3, long spines and blunt process; proximal and middle articles of mandibular palp subequal in length, distal article less than half length of middle article; comb row of marginal setae along middle and distal articles; distolateral corner of distal article with 2-3 long setae.

Maxilla 1 (Fig. 2L) forming large recurved spine; inner lobe simple, with slightly bulbous end.

Maxilla 2 with bifid, setose apex (Fig. 2M).

Maxilliped typical of genus (Fig. 2K); composed of 7 articles, with length of fifth article (third article of palp) 2.5 times width; modified epipod and oostegite arising from base.

Pereon - Pereonite 1 anterolaterally produced, partly covering posterior parts of eyes. Pereonites 1-3 without setae. Dorsum of pereonites 4-7 with setae becoming more numerous posteriorly. Coxae on pereonites 2-7 distinct, becoming progressively more produced posteriorly; anterior coxae subquadrate, posterior coxae gradually becoming more triangular with their posterior angle becoming more acute (Fig. 2A); coxae 3-7 with setae becoming more numerous on posterior somites. Pereonite 7 weakly tuberculate along posterior margin (Fig. 1).

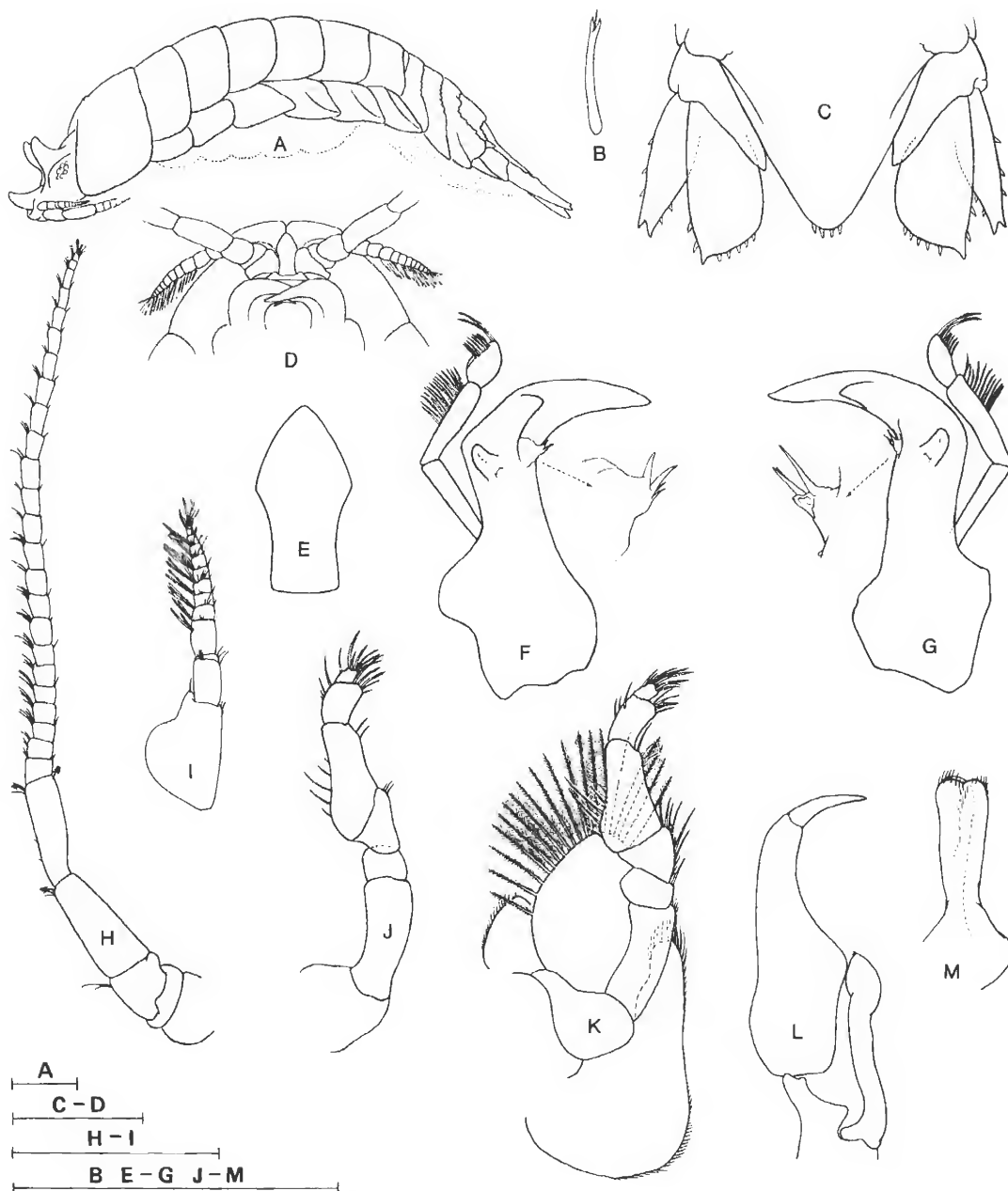


Figure 2. *Excorallana delaneyi*. (A) lateral view (adult male); (B) spinule from dorsum of pleotelson (adult female); (C) dorsal view of pleotelson and uropods of adult female (setae omitted); (D) cephalon, ventral view (adult female); (E) frontal lamina (adult female); (F) left mandible of adult female (lacinia mobilis enlarged); (G) right mandible of same; (H) antenna 1 (adult female); (I) antenna 2 (adult female); (J) maxilliped (adult male); (K) maxilliped (adult female); (L) and (M), maxilla 1 and maxilla 2, respectively, of adult female. Scales = 1 mm.

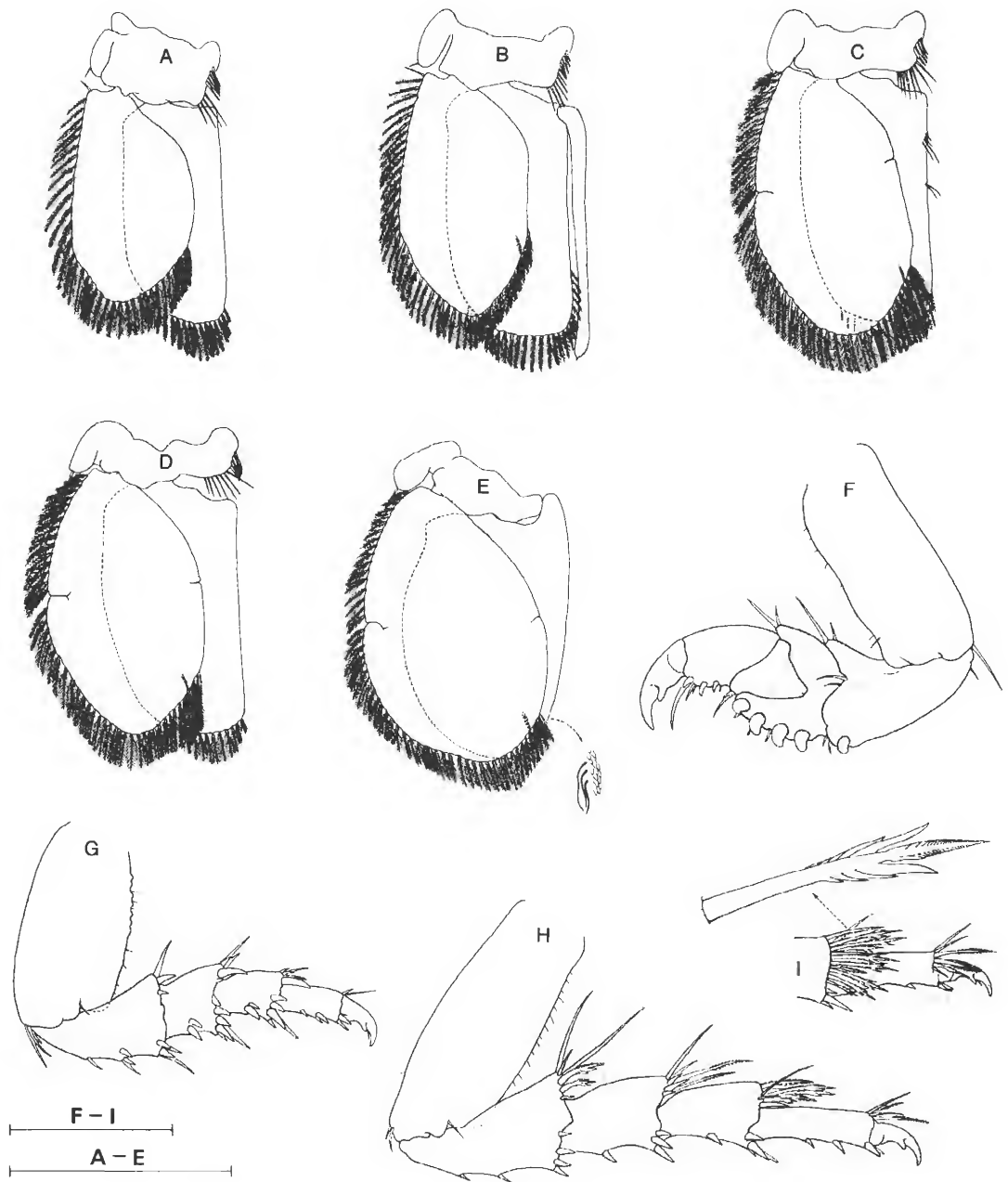


Figure 3. *Excorallana delaneyi*. A-E, right pleopods 1-5 (adult male). F-I, (adult female) - (F) pereopod 1; (G) pereopod 3; (H) pereopod 7, (lateral view); (I) pereopod 7, distal segments (medial view) showing modified setae. Scales = 1 mm.

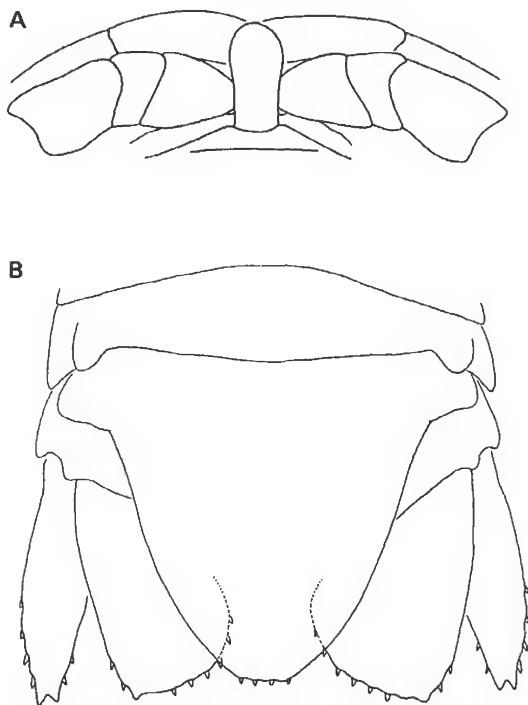


Figure 4. *Excorallana berbicensis* (13 mm subadult female holotype). (A) frontal lamina (setae omitted); (B) telson and uropods (setae omitted).

Pereopods 1–3 prehensile (clinging), directed anteriorly. Pereopod 1 (Fig. 3F) robust; basis with long spinose setae posterodistally; ischium and merus with 1 and 4 stout spines, respectively, on flexor margin, 2–3 long spinose setae on distal extensor margins of both; carpus reduced, triangular, inserted deeply into notch of merus, 2 spines distally on flexor margin; propodus with 3 spines and 1–2 long spinose setae on flexor margin. Propodus and dactylus of nearly equal length; unguis well developed, curved. Pereopods 2 and 3 similar but less robust; carpus inserted into shallower notch of merus.

Pereopods 4–7 ambulatory, directed posteriorly. Pereopod 4 (Fig. 2G) with numerous stout spines extending laterally on distal flexor margins of propodus, carpus, merus, and ischium; spines and spinose setae along extensor margins of same, with setae extending medially. Specialized setae with bilateral blade-like serrations (Fig. 3I) occurring on inner distolateral margin of propodus and carpus, becoming more abundant distally, particularly on carpus. Pereopod 5 similar, but more elongate and with additional serrate blade-like setae on distal extensor margin of ischium. Pereopods 6 and 7 similar with numerous, serrate setae on distomedial margin of carpus (Figs. 3H

and 3I).

Pleon with Pleonite 1 lacking both setae and tubercles, partly or completely covered by pereonite 7. Pleonites 2–5 weakly tuberculate on posterior margins. Pleonite 5 laterally overlapped by pleonite 4. Stout setae (spinules) along dorsum of pleonites 2–5 (Fig. 1).

Pleopods (Figs. 3A–3E) lamelliform. Endopods of pleopods 1–4 with plumose marginal setae along distal margin; such setae absent on endopod of pleopod 5 (Fig. 3E). Exopods of pleopods 3–5 with partial suture (or pleat) indicated by 2 small notches on lateral and medial margins; exopods 2–5 with row of small scale-like structures, with 2–4 annulated setae on their lateral margins, extending inward from distomedial margin (Fig. 3E). Peduncles of pleopods 1–5 with lateral lobe ending in spine; peduncles of pleopods 1–4 with row of 5 (pleopod 1) or 4 (pleopods 2–4) coupling spines and 4–11 plumose setae on medial margin; peduncle of pleopod 5 reduced and lacking such spines and setae on medial margin.

Uropods (Fig. 2C) – Extending slightly beyond apex of pleotelson, bearing plumose marginal setae; endopods subtruncate, length twice as long as width, extending slightly beyond apex of pleotelson, with distinct distal tooth separating 5 submedial and 2 lateral marginal spines; exopods narrow, length 4 times width, with distinct bifurcate tip separating 2 medial and 3 lateral marginal spines.

Pleotelson – Triangular, margins nearly straight, weakly crenulate, bearing plumose setae; apex subacute, with 4 (rarely 6) subterminal spines (Fig. 2C); bifid spinules (Figs. 2B, 7B–D) on dorsal surface, except for narrow region along dorsal midline (Fig. 1).

Description of adult male

Length 8.4–10.8 mm; width 2.6–3.7 mm. Similar to adult female with following exceptions. General body form somewhat smaller. Tuberculation and setation on dorsum of pereon and pleon more pronounced than on adult female.

Cephalon with 3 well developed cephalic horns (Figs. 2A, 6A–C), 1 directed anteriorly as continuation of the rostrum and 2 placed posterolaterally above eyes, directed dorsally; concave depression between cephalic horns.

Pereonite 1 with 2 small submedial tubercles located near anterior margin, usually present on dorsum of males with fully developed horns (Fig. 6A).

Antenna 2 with longer setae and esthetes on flagellar articles than in females (Fig. 6C).

Maxilliped (Fig. 2J) similar to female, but lacking epipod and oostegite.

Male copulatory stylet present (Fig. 3B), arising from proximal medial margin of pleopodal endopod 2, slightly bulbous tip extending just beyond distal end of epipod.

Penes present at bases of pereopods 7.

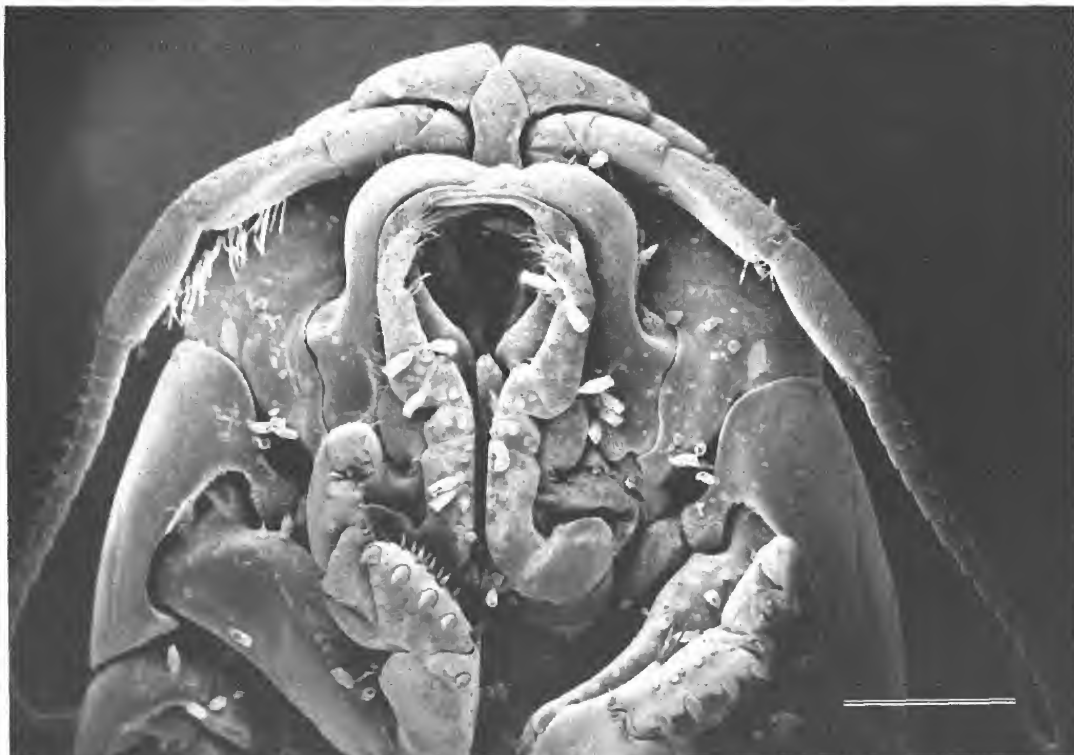


Figure 5. *Excorallana delaneyi*. Anteroventral view of 9 mm subadult female (scale = 500 μ m).

Description of subadults

Subadults, in addition to their generally smaller size, lack or have reduced tuberculation on the dorsum of the pereon and pleon, and lack bifid, spinose setae on the dorsum of the pleotelson (Fig. 7A). Subadult males lack penes and cephalic horns, but, like adult males, have a male stylet on pleopod 2. In large subadult males, the stylet appears as well developed as in adults. The male stylet, although reduced, is present in small juveniles that appear to have just molted from the last manca stage. Like adult males, subadults of both sexes lack modified epipods on their maxillipeds.

Distribution – Presently only known from St. Joseph Bay, Florida.

Coloration – Background colors are dark and light shades of brown to light gray or white. Branching pigmentation pattern on dorsum of body ranging from dark brown to black.

Etymology – This species is named for Paul M. Delaney in recognition of his work on the genus *Excorallana*.

Remarks

Excorallana delaneyi belongs to the "Berbicensis-complex," which includes eight of the 20 known species of the genus. The members of this group differ from the other 12 species of the genus by lacking a pair of notches or incisions in the lateral margins of their telsons. *Excorallana delaneyi* appears to be most similar to *E. berbicensis* Boone, 1918 and *E. longicornis* Lemos de Castro, 1960, the only other species of the Berbicensis-complex that are known to have well developed cephalic horns on the adult males. However, it can be distinguished from these two species by differences in the uropods, pleotelson, and frontal lamina.

The pleotelson of *E. delaneyi* has nearly straight lateral margins and a rounded, relatively constricted apex, whereas on the holotype of *E. berbicensis* the pleotelson has distinctly convex lateral margins and a truncate and broad apex. There are also differences in the spination of the uropods of the two species. The lateral margin of the exopod and the inner margin of the endopod of *E. delaneyi* bear 3 and 5 spines, respectively, while the subadult holotype of *E. berbicensis*

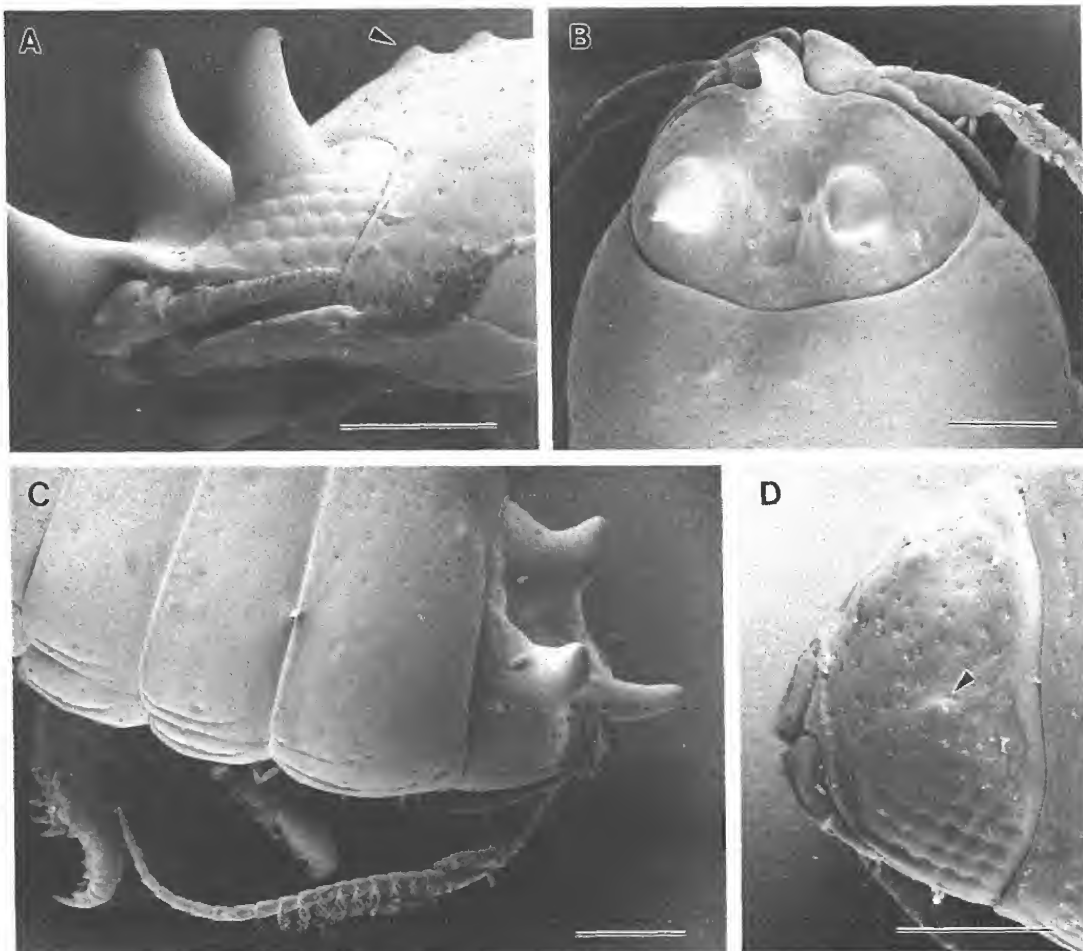


Figure 6. *Excorallana delaneyi*. (A) cephalon of adult male, lateral view; (B) cephalon of adult male, dorsal view; (C) cephalon and right antenna 2 (showing setation) of adult male, dorsolateral view; (D) cephalon of adult female showing rudimentary cephalic horns, dorsolateral view. Scales = 500 μ m.

has 4 and 6 spines on these areas of the uropods. On *E. delaneyi* the apex of the frontal lamina is subacute or bluntly pointed, but in *E. berbicensis* it is rounded. Additional differences between the two species include the larger body size and more weakly developed tooth on the uropodal endopod of the subadult holotype of *E. berbicensis* compared to the adults and subadults of *E. delaneyi*.

The adult males of *E. delaneyi*, like those of *E. longicornis*, have three processes or "horns" on the cephalon and a pair of small tubercles on the dorsum of the first pereonite. The cephalic horns of *E. delaneyi*, however, are shorter and the posterolateral pair is directed dorsally, unlike the long, anteriorly directed pair reported and described for *E. longicornis*.

Another character that may be useful in separating the adult males of the two species is the much longer male stylet on *E. longicornis*. Characters that separate both the adult and large subadult stages of *E. delaneyi* from those of *E. longicornis* include the: (1) more pointed frontal lamina, (2) presence of fewer spines on the dactyl and propodus of first pereopod, (3) presence of more spines on the uropods, and (4) presence of an distinct bifid tip on the uropodal exopod. These same characters, at least in part, were also employed by Monod (1969) and Carvacho (1977) to separate the adults and subadults of *E. berbicensis* from *E. longicornis*.

Excorallana stebbingi Lemos de Castro and Lima, 1976 also appears to be closely related to *E. delaneyi*,

but differs in the following characters: (1) cephalic horns reportedly not present in males, (2) frontal lamina not subacute, but rounded anteriorly as in *E. berbicensis*, (3) subterminal article of maxilliped produced distomedially, almost extending to tip of

terminal article, and (4) the absence of dorsal tubercles on the first pleonal somite.

The following key separates the eight described species of *Excorallana* which lack lateral incisions in the pleotelson:

**KEY TO THE KNOWN SPECIES OF *EXCORALLANA* LACKING
LATERAL INCISIONS IN THE PLEOTELSON**

1. Pleotelson with apical cleft, (Eyes contiguous along medial margin of cephalon) *E. fissicauda* (Hansen, 1890)
- Pleotelson without apical cleft 2
2. Eyes contiguous or fused *E. warmingii* (Hansen, 1890)
- Eyes separate 3
3. Frontal lamina with apex acute or subacute 4
- Frontal lamina with apex rounded or flattened 5
4. Maxilliped with article 3 of palp broad (length less than twice width); pleonites 2-5 with large median tubercle increasing in size posteriorly; males with rostrum, without cephalic horns; uropods having endopods with rounded convex lateral margins and weak apical tooth, exopods weakly bifurcate *E. angusta* Lemos de Castro, 1960
- Maxilliped with article 3 of palp narrow, length more than twice width; males with 3 cephalic horns; uropods, endopods subtruncate with strong apical tooth, apex of exopods distinctly bifurcate *E. delaneyi*, new species
5. Uropods with endopods broad, rounded, without distal tooth; frontal lamina with anterior end flattened, edges rounded; maxilliped with article 3 of palp broad, length less than twice width *E. houstoni* Delaney, 1984
- Uropods with endopods subtruncate, with distinct distal tooth; frontal lamina with anterior end rounded; maxilliped with article 3 of palp elongate, length greater than twice width 6
6. Maxilliped with article 2 having mesiodistal margin elongate, extending parallel to distal end of article 1 to form a subchelate end; adult males apparently lacking cephalic horns *E. stebbingi* Lemos de Castro and Lima, 1976
- Maxilliped not so modified; adult males with 3 cephalic horns 7
7. Pereopod 1 with merus armed with 5 blunt spines; cephalic horns of adult males relatively long, directed anteriorly; pereonite 1 with anterior region having medial depression between 2 well-developed submedian tubercles; uropod with exopod entire *E. longicornis* Lemos de Castro, 1960
- Pereopod 1 with merus armed with 4 blunt spines; cephalic horns of adult males directed dorsally; uropod with exopod bifurcate distally *E. berbicensis* Boone, 1918

DISCUSSION

A series of over 350 specimens of *E. delaneyi* from the type locality was examined, including adults,

subadults, and manca. Based on this series, we consider males with distinct cephalic horns, tubercles on the dorsum of the pleon, and bifid spinules on the pleotelson to be "adults" and those lacking these char-

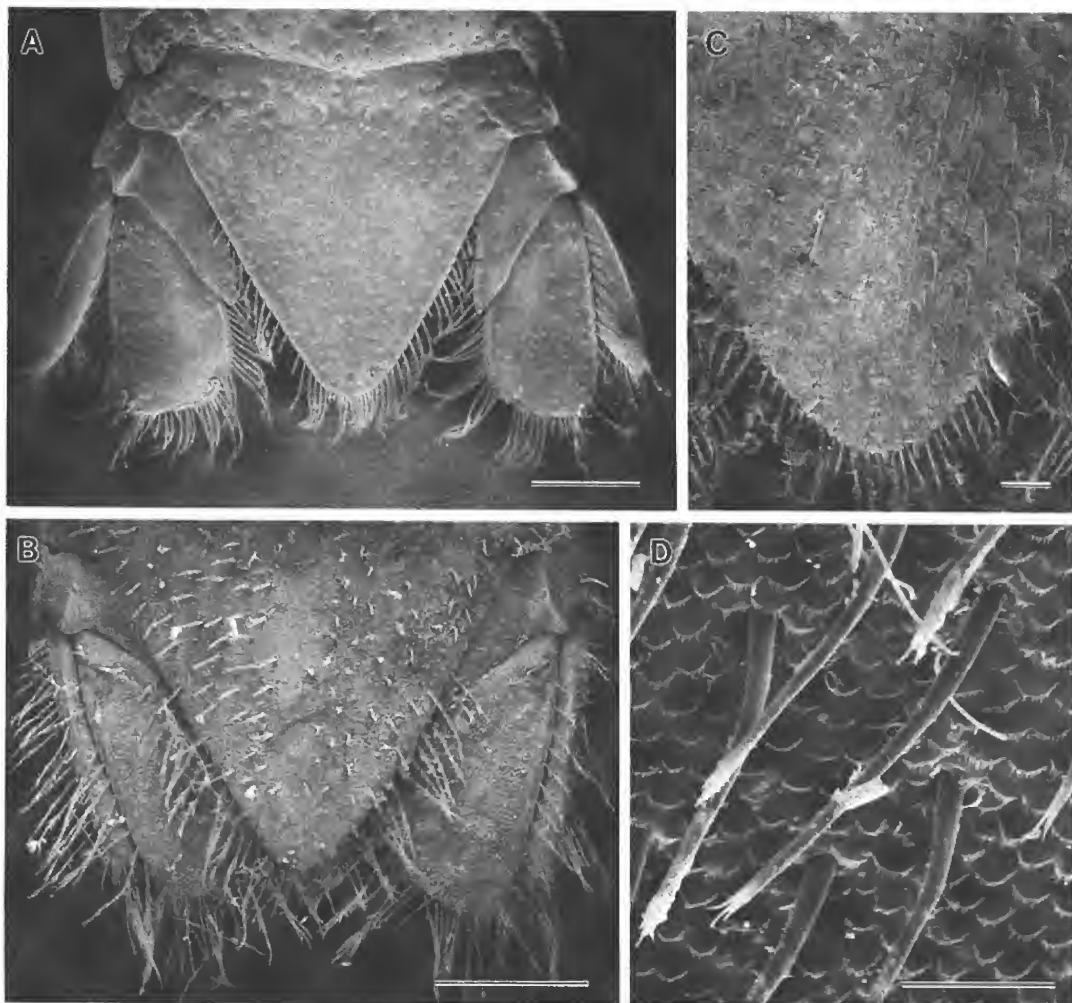


Figure 7. *Excorallana delaneyi*. (A) pleotelson and uropods of large subadult female without dorsal spinules; (B) pleotelson and uropods of ovigerous female showing dorsal spinules; (C) pleotelson of ovigerous female showing dorsal spinules; (D) dorsal spinules enlarged. Scales: A, B = 500 μ m; C = 100 μ m; D = 50 μ m.

acters to be "subadults." Adult females are characterized by having oostegites, as well as pleonal tubercles and bifid spinules on the telson.

Over 30 subadult or incompletely differentiated males without cephalic horns, but with a well developed copulatory stylet on pleopod 2 were examined. Some of these specimens were only a little smaller than horned adults and it might be possible to mistake their lack of horns or pleonal tubercles for valid adult taxonomic characters. This would be especially troublesome when studying a small series of specimens which did not contain fully adult (horned) males. We believe

that for males of *E. delaneyi* the presence of cephalic horns is indicative of sexual maturity; however, as discussed by Monod (1969) this does not preclude the possibility that males lacking horns are sexually mature and that "typical" and "gynecoid" males may occur. To rectify this uncertainty would require histologic and seasonal studies on the reproductive biology of the species. Such studies would be especially useful for other species, such as *E. stebbingi*, whose adult stages are presently characterized as lacking distinct dorsal tubercles on the first pleonal somite and lacking cephalic horns on the male.



figure 8. *Excorallana delaneyi*. (A) protozoans on pereopod, (B) same enlarged. Scales: A = 100 μ m; B = 50 μ m.

Excorallana berbicensis was originally described as lacking cephalic horns and having pleonites devoid of posterior marginal tubercles. We examined the female holotype of *E. berbicensis*, which is a subadult female lacking oostegites and bifid spinules on the dorsum of the pleotelson. The smaller specimen reported by Boone from the type locality also lacks these features and closer examination revealed it to be a subadult male with a well developed stylet on pleopod 2 and indications of developing cephalic horns.

Van Name's (1925, 1936) supplemental description of *E. berbicensis* was based on two specimens, an adult male and female, collected on the gills and pectoral fin, respectively, of different specimens of *Lycengraulis grossideus* (Cuvier). The fish hosts were caught in a tidal fresh or oligohaline area of the British Guiana near the type locality. Van Name described and illustrated the adult male as having cephalic horns and distinct pleonal and pleotelsonic tubercles, but although he described "posteriorly directed hairs" on the pleon, he does not mention or illustrate spinules on the pleotelson. The body lengths of Van Name's two adult specimens are distinctly less (6 and 7.8 mm) than that of the subadult holotype (13 mm). Based on a reexamination of Van Name's material, Brian Kensley (pers. comm.) observed bifid spinules on the pleotelson of both specimens and considers that they may not be conspecific with Boone's type material.

There are two other records of *E. berbicensis* in the literature. Monod (1969) studied specimens from the gills of the lemon shark, *Negaprion brevirostris* (Poey), collected in two freshwater areas of French Guiana. Based on a comparison of the type material of *E.*

berbicensis with the detailed illustrations and supplemental description presented by Monod (1969), we consider his specimens, except for the telson, to be more similar to Boone's type material than to *E. delaneyi*. Carvacho (1977) reported *E. berbicensis* from the island of Guadeloupe, and indicated that his material agreed in all major aspects with the supplemental description and illustrations presented by Monod (1969). A detailed comparison of Monod's and Carvacho's specimens with Boone's type material is needed to verify their identifications.

Males of five species, *E. fissicauda*, *E. oculata*, *E. angusta*, *E. warmingii*, and *E. stebbingi*, belonging to the *Berbicensis*-complex are described as lacking cephalic horns. This condition, coupled with small size of some species such as *E. houstoni*, might indicate a neotenic condition. However, with the possible exception of *E. stebbingi*, these five species are described or illustrated as having dorsal tubercles and spinules on the adults of both sexes, characters which are indicative of the fully developed adults. We do not believe that cephalic horns have arisen independently within the genus, but consider them to be an ancestral or plesiomorphic condition and their absence a derived or apomorphic condition. This view is further supported by the presence of rudimentary or vestigial cephalic horns on the adult females *E. delaneyi* (Fig. 6D).

The presence of rudimentary cephalic horns on the females of *E. delaneyi* may be useful in distinguishing it taxonomically, unless such horns have been overlooked on other females of *Berbicensis*-complex. We believe that the rudimentary cephalic horns on adult females of *E. delaneyi* are not the result of protandry

since no large intermediate forms having vestigial horns, penes, or male copulatory stylets have been observed. If fresh material becomes available, we plan to conduct a histological study of the adult females to determine if vestiges of male gonads are present. Since the adult males that we examined were usually smaller than adult females, we do not consider protogyny (gynandry) to be a possible cause of "horned" condition in females, especially since all of the "horned" females examined had well developed oostegites and many were gravid. Other possible causes may include ecophenotypic or xenobiotic factors which alter or suppress secondary sex characters in the *Berbicensis*-complex, as well as in the other members of the genus. Such factors might involve hormones or other biochemical agents from a host fish's blood or the physiological and biochemical conditions occurring within the isopods' sponge domicile.

Initially we thought the presence of rudimentary horns on large incubatory females of *E. delaneyi* might be caused by a biochemical imbalance or hormonal depletion brought on by senescence or a "spent" reproductive condition. However, after careful reexamination, all of the incubatory females in our collection were found to have at least some remnants of vestigial horns. The females and some males of other species in the *Berbicensis*-complex have either (1) lost the genetic ability to develop cephalic horns or (2) they have developed hormones or associated biochemical reproductive processes which have completely suppressed development of cephalic horns. To test this hypothesis, it would be useful to design experiments to determine if the growth of cephalic horns could be induced or suppressed biochemically in both adult males and females of *E. delaneyi*. Such experiments would be particularly important if conducted on species such as *E. angusta* and *E. stebbingi*, whose males reportedly lack cephalic horns. If the genetic capability to develop cephalic horns in these two species still exists but is being suppressed biochemically in their males (and possibly in their females), then horn development might be induced biochemically under laboratory conditions. Such studies should yield important information on the systematics and biochemical mechanisms involved in inducing or suppressing crustacean secondary sex characters.

The presence of stout spinules on the dorsum of the pleotelson appears to be a reliable indicator of maturity among excorallanid species. In Menzies' (1962) description of *E. kathyae* Menzies, 1962 (= *E. truncata* Richardson, 1899), such bifid spinules were mentioned as a taxonomic character for the species, and Menzies and Kruczynski (1983) noted the presence of similar spinules on *E. tricornis tricornis* (Hansen 1890) and *E. mexicana* (Richardson 1905). The spinules on the latter are slightly different in that they are weakly serrate; however, the spinules on both species have the characteristic forked tip with sensory hair as illustrated for *E.*

delaneyi (Figs. 2B, 7D). The dorsal spinules on the pleotelson of *E. antillensis* as described by Menzies and Kruczynski (1983) are not bifid, but are conical and "burr-like." However, they do have apical sensory hairs and a submedial arrangement similar to some other species of *Excorallana*.

Excorallana stebbingi was briefly described from a relatively small series of specimens. A supplemental or redescription based on a larger series of specimens is needed. Lemos de Castro (1976) does report the presence of "stout hairs" on the pleotelson, but gives no detailed illustration of these structures. If these "stout hairs" are homologous with the various modified "spinules" characteristic of the adult forms of *E. delaneyi* and other species of *Excorallana*, they could be very useful in distinguishing between subadult and adult males for the species whose males lack horns.

Specialized serrate setae (Fig. 3I) similar to those present on pereopods 4-7 of *E. delaneyi* (Fig. 3I) have been reported on *E. antillensis*, *E. berbicensis* and *Corallana hirsuta* Schioedte and Meinert (see Hansen 1890; Monod 1934, 1969). These distinct setae may have been overlooked or not described for several species of *Excorallana* related genera. The fine structure and location of these setae on the pereopods might prove to be useful characters in future studies on the taxonomy of *Excorallana* and related genera.

ECOLOGICAL NOTES

Three other species of *Excorallana*, *E. tricornis occidentalis* Richardson, 1905, *E. bruscai* Delaney, 1984, and *E. quadricornis* (Hansen, 1890) have been reported as occasional commensals of sponges (see Delaney 1984), but apparently not to the exclusive degree that we have observed for *E. delaneyi*. During this study, *Excorallana delaneyi* was found associated with two sponges, *Halichondria* sp. and *Hymeniacidon* sp. At the type locality in the upper part of St. Joseph, *Halichondria* sp. was the most common and heavily infested of the two host sponges. A single specimen of *Halichondria* sp., approximately 30 cm in diameter, contained over 75 individuals of *E. delaneyi* in various stages of maturity (manicas, subadults, adults). Examination of the three other common sponges, *Microciona prolifera* (Ellis and Solander) and two unidentified species, from the vicinity of the type locality did not yield specimens. Extensive collecting and examination of other possible hosts and microhabitats within the grassbeds at the type locality did not yield additional specimens of *E. delaneyi*. The collecting gear used included a kick net and an A-frame scallop dredge, both with 1 mm mesh netting.

All specimens of *E. delaneyi* that we examined came from sponges collected in *Thalassia* grassbeds at St. Joseph Bay, Florida. Two or more individuals of *E. delaneyi* were often found inhabiting the same chamber

or cavity within the sponge. Another isopod, *Paracerceis caudata* (Say 1818), was found associated with the sponge hosts of *E. delaneyi*. This sphaeromatid occurred in far fewer numbers and was limited to the depressions and more accessible canals on the surface of the sponge. *Excorallana delaneyi* usually occupied cavities and canals deeper within the sponge host. Other invertebrates commonly found on or within the sponge hosts of *E. delaneyi* included the decapods, *Dyspanopeus texana* (Stimpson 1859), and *Alpheus* sp.; the amphipods, *Dulichtiella appendiculata* (Say 1818), *Leucothoe* sp., *Colomastix* sp.; and the polychaetes, *Haplosyllis spongicola* (Grube 1855), unidentified terebellids, and *Marphisia* sp.A.

When removed from its sponge host, *E. delaneyi* exhibited a constant grasping behavior when in the presence of suitable object or substratum. It also was observed to be an excellent swimmer. When specimens were placed in an aquarium, they usually swam rapidly for about a minute before forming spherical aggregations by clinging together in groups of 10 or more individuals. When a small piece of the host sponge was placed with these isopods they quickly burrowed inside, until the spongy frame was engorged with a mass of isopods. Other macroinvertebrates and small fishes placed in the same aquarium were generally ignored. In several instances, groups of manca and juveniles were found within the thoracic cavities of dead or dying adult *E. delaneyi*. We did not determine if this behavior represented cannibalism or an instinctive burrowing response. Notwithstanding, this behavior was probably an aberration caused by our attempt to maintain the specimens under laboratory conditions in the absence of their normal food source and sponge domicile.

Members of the genus *Excorallana* are known to parasitize fishes, including sharks and rays (Van Name 1925, Monod 1969, Menzies and Glynn 1968, Delaney 1984), thus indicating the possibility that *E. delaneyi* may parasitize fish during some stage of its development, retiring to the sponge host to molt and reproduce between feedings. Many of the specimens collected had guts greatly swollen with what appeared to be blood indicating that they may have recently fed on a fish host. During our limited survey, *Excorallana delaneyi* was not found on the several fish species — *Opsanus beta* (Goode and Bean), *Lagodon rhomboides* (Linnaeus), *Menidia beryllina* (Cope), *Fundulus similis* (Baird and Girard), *Fundulus grandis* (Baird and Girard), *Cyprinodon variegatus* Lacepede, and *Mugil cephalus* Linnaeus — examined from the type locality. Since *Excorallana berbicensis*, *E. t. tricornis*, and *E. tricornis occidentalis* are known to parasitize fishes (Delaney 1984), our limited observations do not preclude the possibility that *E. delaneyi* may intermittantly

parasitize fishes during all or part of its life cycle. Monod (1969) reported *E. berbicensis* as a parasite of the lemon shark *Negaprion brevirostris* in South American waters. Lemon sharks occur in the vicinity of the type locality of *E. delaneyi*; however, we have not had an opportunity to examine specimens from this area. Examination of sharks, rays, and a larger number of other fish species collected during both night and daylight hours from the type locality is needed to confirm the presence of a fish host.

Protozoans, loricated peritrichs similar to those reported by Delaney (1982), were often found attached to the body surface, especially the pleopods, mandibles, and pereopods of the larger specimens of *E. delaneyi* examined (Figs. 5, 7, 8). Another symbiont, and epicaridian isopod parasite most closely resembling the cabiropsid genus *Clypeoniscus* Giard and Bonnier, was found within the brood chamber of female *E. delaneyi*. To our knowledge, there are no previous reports of cabiropsid isopods occurring on members of the family Excorallanidae. The description of this apparently new species of *Clypeoniscus* will be the subject of another publication.

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SHORT COMMUNICATIONS

INVERTEBRATES ASSOCIATED WITH THE THINSTRIPE HERMIT *CLIBANARIUS VITTATUS* (BOSC) (CRUSTACEA: DECAPODA: DIOGENIDAE) FROM THE BARRIER ISLANDS OF MISSISSIPPI

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ABSTRACT Hermit crabs, the gastropod shells that they inhabit, and associated epifauna constitute a motile microhabitat. Twenty-three macroscopic, epifaunal invertebrates were associated with the diogenid crab *Clibanarius vittatus* in Mississippi coastal waters. Epibiotic growth may discourage predation of the crab, reduce competition for the shells, or provide an advantage in agonistic shell interaction. In addition, the shell provides a hard substrate for settling and attachment of epifauna in an area that is largely devoid of hard substrate. Reduced sedimentation and prevention of shell burial, improved food availability, transport, and protection from predation may also be advantageous to the epizoans.

INTRODUCTION

Hermit crabs and associated fauna have been discussed in the literature (Jensen and Bender 1973; Stachowitsch 1980), much of which concerns the association of anemones and hydroids with hermit crabs (Ross 1960, 1971; Jensen 1970; Jensen and Bender 1973; McLean and Mariscal 1973; and Wright 1973). Other known or possible symbionts rarely have been cataloged (Jensen and Bender 1973, Fotheringham 1976, Stachowitsch 1980). This study presents a faunistic survey of macroscopic invertebrates associated with the diogenid crab *Clibanarius vittatus* (Bosc) in the coastal waters of Mississippi. This report parallels Fotheringham's (1976) findings and reports a number of additional species. However, 14 species symbiotic with *C. vittatus* are reported here for the first time. Fotheringham (1976) reports 11 species from Texas specimens also found here.

Site description

Specimens were collected from five littoral sand beach sites on two barrier islands, Horn and Ship, approximately 10 and 15 km south of the mainland coast of Mississippi, respectively, in the Gulf of Mexico (Fig. 1). The gradually sloping, low wave-energy beaches of well-sorted quartz sand experience diurnal tides with a mean tidal range of 0.55 m. Near-

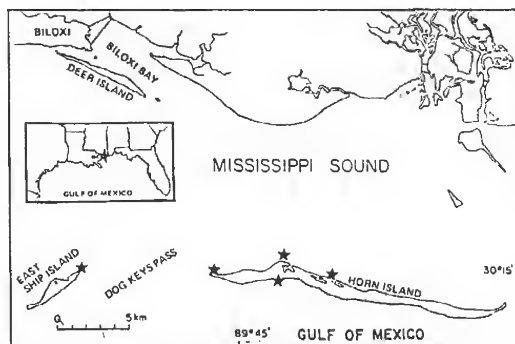


Figure 1. Location of collection sites.

shore submerged grass flats and submergent/emergent tree stumps of a flooded maritime forest provide areas where crabs aggregate. Tidal lagoons that are dominated by *Spartina* marsh and deeper water channels and passes are adjacent to collection sites.

METHODS

A total of 1,818 specimens of *C. vittatus* was collected in a more or less random fashion in < 1 m of water within the littoral zone. Specimens were col-

lected between 1 June and 15 July 1981. Each specimen was visually examined and the presence of live organisms on or within the visible portions of the shell noted. Individuals of each symbiont were retained and preserved in 10% formalin for identification.

RESULTS

Of the crabs that were examined, 70% harbored associated epifauna that represented seven phyla and 23 invertebrate species (Table 1). Acorn barnacles (*Balanus* spp., 44.5%) and slipper shells (*Crepidula* spp., 22.3%) were the most abundant symbionts encountered. All other symbionts occurred on less than 10% of the total crabs examined.

Porifera

The boring sponges *Cliona celata* and *C. truitti* were endolithic in 11 (0.6%) of the shells.

Cnidaria

The star coral *Astrangia poculata* (= *astreiformis*, = *danae*) infested 45 (2.5%) of the shells. A single specimen of the tricolor anemone *Calliactis tricolor* was collected. Only one crab was found with a thriving colony of the hydroid *Hydractinia echinata*, although several shells showed evidence of previous colonization.

Platyhelminthes

A single specimen of the oyster leech *Stylochus ellipticus* was observed (others might have been found if the shells had been broken).

Polychaeta

The polynoid polychaete *Lepidonotus sublevis* and the nereid polychaete *Nereis* (syn. *Neanthes*) *succinea* were commonly encountered, infesting 103 (5.7%) and 109 (6.0%) of the shells, respectively. *Lepidonotus sublevis* was usually found in the siphonal canal of whelks of the genus *Busycon* and the umbilicus of the moon snail *Polinices duplicatus*; up to three specimens of *L. sublevis* were found associated with some large crabs. Specimens of *N. succinea*, however, were found in small bore holes within the shell, in the tubes of serpulid worms, and crawling freely within or on the shells. Calcareous tubes of the serpulid worms *Hydroides* spp. were present on many shells, but no living polychaetes were found. Only three specimens of the polychaete *Polydora websteri* were noted; however, polychaetes that were retracted into their burrows may have been overlooked.

Mollusca

Slipper shells (*Crepidula* spp.) were abundant, occurring on 406 (22.3%) of the shells, and were frequently found in large numbers; several crabs had 25+ individual *Crepidula* per shell. *Crepidula plana* was the most abundant species, although many specimens of *C. maculosa* and a few specimens of *C. fornicata* were also noted. Several other small gastropods were noted on the exterior of some crab-inhabited shells. Specimens of *Cantharus cancellarius* (2, 0.1%), *Anachis simplicata* (5, 0.2%), and *Boonea impressa* (23, 1.3%) were also observed. In addition, 93 (5.1%) of the shells carried the southern oyster drill, *Thais haemastoma*. Small oysters were present on 180 (9.9%) of the shells, with as many as 30+ specimens on a single shell. *Ostrea equestris* and *Crassostrea virginica* were both present as adults in the study area.

Crustacea

Acorn barnacles *Balanus improvisis* and *B. amphitrite* were the most prevalent associate, infesting 810 (44.5%) of the shells. Several small crabs were present. The porcelain crab *Porcellana sayana* was the most prevalent and occurred with 112 (6.2%) of the hermit crabs; up to four individuals occurred with a single crab. This species is known to inhabit the shells of other diogenid species, notably *Petrochircus diogenes* (Hedgepeth, 1953). In addition, juvenile portunid and xanthid crabs were also noted. One adult xanthid, *Hexapanopeus angustifrons*, was identified. Two amphipods, *Talorchestia* sp. and *Hyale* sp., and the isopod *Syphaeroma quadridentatum* were observed, but only in small numbers: 2 (0.1%), 6 (0.2%), and 8 (0.4%), respectively.

Bryozoa

Colonies of the encrusting bryzoan *Membranipora* sp. were common; 98 (5.2%) of the shells harbored live colonies, while 278 (15.7%) of the shells showed evidence of previous colonies. *Membranipora* is a common fouling organism of this area (Gunter and Geyer, 1955).

DISCUSSION

Hermit crabs exhibit distinct shell preferences based on the availability of shells in a given locale (Reese 1962). The shell-use pattern of *C. vittatus* in Mississippi Sound is included (Table 2). Since the shell substrate itself may affect the associated epifauna, the shell substrate of each symbiont is also noted (Table 1).

TABLE 1

Prevalence of epifauna associated with *Clibanarius vittatus*, with reference to the gastropod shell species inhabited by the crab and the number of crabs infested by each symbiont. Dashed line indicates no specimens collected.

Total *Clibanarius* examined = 1,818.

Taxon	Symbionts	T	Gastropod Shell*			O	Total # of <i>Clibanarius</i> Infested	Percent of Total
			P	B				
Porifera	<i>Cliona</i> spp.	7	1	3	-		11	0.60
Cnidaria	<i>Astrangia poculata</i> (Ellis & Solander)	45	-	-	-		45	2.47
	<i>Calliactis tricolor</i> (Lesueur)	1	-	-	-		1	0.06
	<i>Hydractinia echinata</i> Fleming**	1	-	-	-		1	0.06
Platyhelminthes	<i>Stylochus ellipticus</i> (Girard)**	1	-	-	-		1	0.06
Annelida, Polychaeta	<i>Nereis succinea</i> (Frey & Leuckart)**	81	13	15	-		109	5.99
	<i>Lepidonotus sublevis</i> Verrill**	62	34	7	-		103	5.66
	<i>Polydora websteri</i> Hartman**	3	-	-	-		3	0.16
Mollusca	<i>Crepidula</i> spp.**	184	93	126	4		407	22.38
	Oysters	122	25	32	1		180	9.89
	<i>Thais haemastoma</i> (Lamarch)**	59	11	23	-		93	5.10
	<i>Boonea</i> (= <i>Odestomia</i>) <i>impressa</i> (Say)	9	6	8	-		23	1.26
	<i>Anachis simplicata</i> (Stearns)**	1	2	2	-		5	0.20
	<i>Cantharus cancellarius</i> (Conrad)	1	-	1	-		2	0.10
Arthropoda, Crustacea	<i>Balanus</i> spp.**	564	143	100	3		810	44.50
	<i>Porcellana sayana</i> (Leach)**	74	10	27	1		112	6.15
	Juvenile crabs (xanthid & portunid)**	11	2	3	-		16	0.88
	<i>Sphaeroma quadridentatum</i> Say	5	1	2	-		8	0.44
	<i>Hyale</i> sp.	2	-	-	6		8	0.44
	<i>Talorchestia</i> sp.	-	-	-	2		2	0.10
	<i>Hexapanopeus angustifrons</i> (Benedict & Rathbun)	-	-	-	1		1	0.06
Bryozoa	<i>Membranipora tenuis</i> Desor							
	Live colonies	68	16	14	-		98	5.38
	Dead colonies	198	30	50	-		278	19.89

*T = *Thais haemastoma*, P = *Polinices duplicatus*, B = *Busyon* spp., O = Other

**Species noted by Fotheringham

TABLE 2
Shell-use pattern of the Mississippi population
of *Clibanarius vittatus*.

Gastropod Shell Species	Total No.	% of Total
<i>Thais haemastoma</i> (Lamarch)	1219	67.05
<i>Polinices duplicatus</i> (Say)	400	22.00
<i>Busycon contrarium</i> (Conrad)	178	9.79
<i>Cantharus cancellarius</i>	10	0.55
<i>Busycon spiratum</i> (Lamarck)	7	0.39
<i>Fasciolaria lilium</i> Fischer	3	0.17
<i>Strombus alatus</i> Gmelin	1	0.06

The hermit crab's motile community is a dynamic phenomenon that can be viewed as functional unit, although exact relationships between the crab and its shell cohabitants are difficult to assess. A few symbionts such as *Hydractinia* are known to be associated only with hermit crabs and can be termed obligatory symbionts. Generally speaking, interactions between facultative (nonobligatory) symbionts can be viewed as enhancing or reducing survivability of either organism.

Several significant advantages to the crab have been proposed:

(1) The epibiotic growth may help to conceal the animal from predators. (2) Some epibiotic species such as *Hydractinia* and *Calliactis* (Wright 1973) may actually discourage predation (Ross 1971), or reduce competition for shells. (3) Those epizoans that secrete CaCO_3 structures (such as barnacles and oysters) may also serve to discourage predators by increasing shell strength (Stachowitsch 1980). (4) Epibiotic growth may make the shell appear larger and thus is advantageous in agonistic interaction (Hazlett 1970).

Several advantages also exist for the epizoans:

(1) The presence of a hard surface exists for attachment (Stachowitsch 1980). Such suitable substrate may explain the presence of *Cliona*, *Hydractinia*, *Astrangia*, *Polydora*, *Ostrea*, *Crassostrea*, *Crepidula*, *Balanus*, and *Membranipora*. Hard substrates are sparse along the Mississippi coast; most surface sediments are mud, sand, or a mixture thereof. Gastropod shells, therefore, represent small islands of suitable habitat to organisms that would otherwise find few acceptable settlement areas. Certainly the abundance of *Balanus* (44.5%), *Crepidula* (22.4%), *Ostrea* (9.8%), and *Membranipora* colonies (5.3% live and 19.8% dead) indicates the importance of hard substrate.

(2) Reduced sedimentation and prevention of shell burial is advantageous (Conover 1975). The constant foraging activity of the crab keeps its symbionts free of sediment and detritus which might interfere with respiration or feeding.

(3) Improved food availability to the epibionts is increased by a crab's respiratory currents as well as its passage through the water and feeding activities. An improved current for filter feeders is generated by the crab's normal respiratory activity and active movements. Organisms thus benefited include: *Cliona*, *Hydractinia*, *Astrangia*, *Calliactis*, *Ostrea*, *Crassostrea*, *Crepidula*, *Balanus*, *Porcellana*, and *Membranipora*. Additionally, small worms (*Lepidonotus*, *Nereis* [syn. *Neanthes*], *Polydora*), crabs (*Porcellana*) and juvenile xanthid and portunid crabs probably benefit from both particulate material stirred up by the crab as it passes and particles liberated as the crab tears and masticates its own food. The relationship may be even more direct. Brightwell (1951) noted that *Neanthes* positioned itself amidst the mouthparts of the hermit crab *Pagurus* (syn. *Eupagurus*) *bernhardus* (L.) while both were feeding.

(4) Transport is another distinct advantage. Phoresy (the passive transport of one organism by another) was proposed by Cake (1983) as the reason for the presence of *Thais haemastoma* on hermit crabs (*C. vittatus*) and blue crabs (*Callinectes sapidus*) in the same locale. Phoresy may account for the presence of *Cantharus*, *Anachis*, and *Boonea*. Dispersal into new feeding areas would certainly be facilitated by accompanying the active hermit crabs.

(5) Protection from predation is also a major advantage for association. The siphonal notch, the umbilicus, ridges, spires, projections, and interior whorls provide a number of hiding places for these small invertebrates. Mississippi coastal substrate generally lacks structural diversity, and shells thus provide structural alternatives for hiding the epibiont. *Lepidonotus*, *Nereis*, and *Crepidula* were usually found in the shell cavity along with *Porcellana* and other juvenile crabs. *Lepidonotus* was also frequently found in the umbilicus of *Polinices* shells.

The presence of the amphipod *Talorchestia* within the hermit crab's "shell" is probably accidental. The amphipod was collected from crabs that were actively feeding in the same area that contained large numbers of these semiterrestrial amphipods. During the disturbance of specimen collection, the amphipod may have been collected inadvertently. However, the amphipod, *Hyale* sp., and the isopod, *Sphearoma*, are characteristic of epibiotic and fouling communities in Mississippi.

Associated invertebrates may also suffer disadvantages from the relationship. *Clibanarius* often forages in the upper littoral zone and can withstand stranding at low tide. Stranding subjects the symbionts to desiccation and thermal and osmotic stresses. Even slight exposure stresses organisms such as *Hydractinia*

and *Calliactis*, and such temporary strandings may account for the virtual absence of these epibionts that are common on sympatric hermit crab species that do not forage above the low tide line in Mississippi Sound. This intertidal existence also subjects associates on the outer shell to abrasion as the crab is rolled by wave action. Furthermore, *C. vittatus* as an adult is an estuarine organism. Symbionts which cannot tolerate the wide fluctuations in salinity, temperature, and turbidity that are associated with estuarine habitats will not survive.

These discussion items are based on observation, and suggest that experimental studies to determine the

exact relationships between crabs and associates are needed.

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